ASSESSMENT OF THE PROFITABILITY AND SENSITIVITY DYNAMICS OF RICE PRODUCTION IN NASARAWA STATE

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ABSTRACT

This study assessed the profitability and sensitivity dynamics of rice production in Nasarawa State, Nigeria. Rice, being a staple food crop and a critical component of food security in Nigeria, has witnessed significant growth in demand driven by population growth and urbanization. Nasarawa State faces challenges related to production costs, market volatility, and socio-economic constraints, despite being one of the leading rice-producing states in Nigeria. This research employs a quantitative approach to evaluate profitability using Net Farm Income (NFI), Return on Investment (ROI), and Benefit-Cost Ratio (BCR), while sensitivity analysis was conducted to examine the responsiveness of profitability to variations in input and output prices. Data were collected from 240 rice farmers across selected Local Government Areas through structured questionnaires and analyzed using descriptive statistics, profitability analysis, and sensitivity analysis. The results revealed that rice production in Nasarawa State is profitable, with a net farm income of ₦533,000 per hectare, an ROI of 69.5%, and a BCR of 1.7. However, profitability declines significantly with rising production costs and falling revenue, highlighting vulnerability to economic fluctuations. The sensitivity analysis shows that a 20% increase in production cost or a 20% fall in revenue is the maximum threshold for maintaining profitability. Major constraints identified include inadequate capital, lack of processing and storage facilities, herders' invasion, and high transportation costs. The study recommends enhancing financial support, improving processing infrastructure, and addressing security challenges to sustain profitability and resilience among rice farmers.

Keywords: Profitability, sensitivity, rice production, constraints, Nasarawa State

INTRODUCTION

Rice (*Oryza sativa L.*) remains a staple food crop and a critical component of food security in Nigeria, contributing significantly to the dietary needs of millions of households and the national economy (Adeyemo, Ogunjimi & Farinde, 2020). Nigeria is one of the largest producers and consumers of rice in West Africa, yet it struggles to meet domestic demand, relying heavily on imports to bridge the supply gap ((Ezeh, Anyiro & Chukwu, 2018; Adebayo & Ojo, 2022). And its consumption has grown significantly over the years due to urbanization, population growth, and changing dietary preferences (Olagunju, Adesiyan & Ojo, 2019). This situation has prompted the Nigerian government to implement policies aimed at boosting local rice production, such as the Anchor Borrowers' Program and import restrictions on rice (Okeke, Ezeh & Anyiro,

2021). The North Central region of Nigeria, including Nasarawa State, has emerged as a vital hub for rice cultivation due to its favourable agro-climatic conditions, fertile soils, and access to water resources, making it a significant contributor to national rice production ((Adeyonu, Okunlola & Ogunniyi, 2020; Usman, Ademola & Oni, 2024). Despite this potential, the sustainability and profitability of rice production in the region remain under threat due to rising production costs, fluctuating market prices, and various socio-economic and environmental constraints faced by farmers.

Profitability analysis in agriculture serves as a critical tool for assessing the economic viability of crop production systems. It provides insights into the returns on investment and the financial incentives for farmers to continue production (Obisesan, 2017). Profitability in rice production is influenced by several factors, including input costs, output prices, and production efficiency (Ojo, Ogunniyi & Adeyemo, 2017). Inputs such as seeds, fertilizers, and labour constitute a significant portion of production costs, and fluctuations in their prices can have a profound impact on farmers' net returns (Adeyemo *et al*., 2020). Similarly, the price of rice at the market is subject to variability due to factors such as supply chain disruptions, seasonal variations, and market speculation (Olagunju *et al*., 2019). Understanding the sensitivity of rice production profitability to changes in input and output prices is crucial for developing strategies to mitigate risks and enhance the resilience of rice farmers (Ezeh *et al*., 2018).

In Nasarawa State, rice farming is predominantly practiced by smallholder farmers who rely on both traditional and semi-mechanized techniques. Studies have shown that rice production can be profitable when optimal input levels and efficient resource use are achieved (Usman *et al*., 2024). However, profitability is often undermined by high input costs, particularly for labour, fertilizers, and herbicides, as well as variability in output prices (Tarfa *et al*., 2019). Understanding the profitability dynamics of rice production in Nasarawa State is therefore essential for designing policies that enhance farmers' income and promote sustainable agricultural growth.

Beyond profitability, the sensitivity of rice production to changes in input and output prices is a crucial factor influencing farmers' economic resilience. Sensitivity analysis examines how variations in costs (e.g., seeds, fertilizers, and labour) and revenue (e.g., rice market prices) affect profit margins, providing a deeper understanding of the risks farmers face in volatile markets (Rondhi, Khasan, Mori & Kondo, 2019). In Nigeria, rice farmers are particularly vulnerable to price fluctuations due to inadequate market infrastructure, poor access to credit, and reliance on rain-fed systems, which amplify production risks (Adebayo & Ojo, 2022). Evaluating the sensitivity of profitability in Nasarawa State will reveal the extent to which farmers can withstand economic shocks and inform strategies to stabilize their income streams.

Furthermore, rice farmers in Nigeria, including those in Nasarawa State, encounter numerous constraints that limit their productivity and profitability. These challenges range from inadequate access to finance and farm inputs to poor infrastructure, pest and disease infestations, and climate variability (Olufemi, Joshua & Salamatu, 2021; Usman *et al*., 2024). Additionally, issues such as poor marketing systems, unstable prices, and inadequate extension contacts further exacerbate the difficulties faced by rice farmers in the region (Kagbu, Omokore, & Akpoko, 2016). The Garrett Ranking method, a widely used technique for prioritizing constraints, has been employed in agricultural studies to identify and rank the most pressing challenges faced by farmers (Obisesan, 2017). Identifying and prioritizing these constraints in Nasarawa State will provide a clearer picture of the barriers to rice production and guide targeted interventions to address them.

Given the strategic importance of rice in Nigeria's quest for food security and economic diversification, assessing the profitability and sensitivity dynamics of rice production in Nasarawa State is timely and relevant. This study builds on previous research by integrating profitability analysis with sensitivity dynamics and constraint identification, offering a comprehensive perspective on the rice production landscape in the state. The findings are expected to contribute to evidence-based policymaking aimed at enhancing rice farmers' livelihoods and reducing Nigeria's dependence on rice imports.

METHODOLOGY

This study adopts a quantitative research design to assess the profitability and sensitivity dynamics of rice production in Nasarawa State, Nigeria, while employing a qualitative ranking method to identify constraints. The methodology integrates economic analysis with statistical tools to achieve the stated objectives:

Profitability Assessment: Profitability is determined using the Net Farm Income (NFI) model, where NFI = Total Revenue (TR) – Total Cost (TC). TR is calculated as the product of rice yield (kg/ha) and market price (N/kg), while TC includes both variable costs (e.g., seeds, fertilizers, labour) and fixed costs (e.g., land rent, equipment depreciation) (Mark, Ohajianya, Obasi & Onyeagocha, 2019).

Sensitivity Analysis: Sensitivity dynamics are evaluated by simulating changes in key variables—input costs and output prices—within a range of ±10%, ±20%, and ±30%. The impact on NFI is computed to determine the elasticity of profitability to these fluctuations (Abdullahi *et al*., 2021).

Constraints Identification: The Garrette Ranking Method is employed to rank constraints based on farmers' responses. Farmers assign ranks to identified constraints, which are then converted into percentage scores using the formula:

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

Where

Rij = Rank given for the i^{th} constraint by j^{th} respondent

Nj = Number of constraints ranked by j^{th} respondents

The constraint with the highest score is deemed the most severe.

Primary data were collected through structured questionnaires and interviews, supplemented by secondary data from agricultural reports and government publications.

Study Area

The study was conducted in Nasarawa State, located in the North Central geopolitical zone of Nigeria. Geographically, it lies between latitudes 7°45'N and 9°25'N and longitudes 7°00'E and 9°35'E, covering an area of approximately 27,117 km². The state shares boundaries with Kaduna and the Federal Capital Territory (FCT) to the north, Benue and Kogi States to the south, Taraba and Plateau States to the east, and FCT to the west (Yusuf *et al*., 2022). Nasarawa State is characterized by a tropical climate with distinct wet (April–October) and dry (November–March) seasons, receiving an annual rainfall of 1,200–1,500 mm, which supports rice cultivation.

The state's topography includes lowland areas

conducive to rice farming, particularly along the floodplains of rivers such as the Benue and Farin Ruwa. Agriculture is the backbone of the economy, employing over 70% of the population, with rice being a major staple crop alongside yam and maize (Ejeh & Ojo, 2020). Nasarawa State is a significant rice-producing region in Nigeria, contributing to both local consumption and national food security. The selection of this area is justified by its agroecological suitability for rice production and the prevalence of smallholder farming systems, which align with the study's focus.

Sampling Technique and Data Collection

A multistage sampling technique was employed to select respondents for this study, ensuring representativeness across Nasarawa State's rice-producing zones:

Stage one involved purposive selection of three Local Government Areas (LGAs)—Doma, Obi and Lafia—based on their high rice production potential, as identified in previous studies (Yusuf *et al*., 2022). In stage two, from each of the selected LGA, four rice-farming communities were randomly selected, yielding 12 communities in total. In the last stage, within each community, 20 rice farmers were randomly sampled, resulting in a total sample size of 240 farmers (3 LGAs × 4 communities × 20 farmers).

Primary data were collected using a structured questionnaire administered via face-to-face interviews. The questionnaire captured socioeconomic characteristics (e.g., age, education, farm size), production costs, revenue, and perceived constraints. Secondary data, including input and output price trends, were sourced from the Nasarawa Agricultural Development Programme (NADP) and the National Bureau of Statistics (NBS) for the period 2017-2024. Data collection occurred between October, 2024 and December 2024.

Data Analysis

Data analysis was conducted using descriptive statistics, profitability analysis, sensitivity analysis, and Garrette Ranking.

Profitability Analysis: Descriptive statistics (means, percentages) were used to summarize costs, revenues, and NFI per hectare. The profitability index (PI = NFI/TC) and return on investment (ROI = NFI/TC × 100) were calculated to assess economic viability (Mark *et al*., 2019).

Sensitivity Analysis: A deterministic sensitivity model was applied, input costs and output prices were varied incrementally (±5%, ±10%, ±15%, up to ±50%), and the resulting changes in NFI were recorded.

Constraints Analysis: The Garrette Ranking Method was used to prioritize constraints. Ranks assigned by farmers were converted into scores, and the constraint with the highest average score was identified as the most critical (Garrett & Woodworth, 2015). Descriptive statistics (frequencies, means) complemented this analysis to describe constraint prevalence (Yusuf, Balli & Audu, 2020).

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Respondents

Table 1: Socioeconomic and Production Characteristics of Respondents

Characteristic	Frequency	Percentage
Gender		
Female	51	21
Male	189	79
Total	**240**	**100**
Age (Years)		
Less than 25	11	4.6
25 – 35	41	17.1
36 – 45	89	37
46 – 55	67	28
More than 55	32	13.3
Total	**240**	**100**
Marital status		
Married	201	83.75
Unmarried	39	16.25
Total	240	100
Family size		
1-3	48	20
4-6	106	44
>6	86	36
Total	**240**	**100**
Level of Education		
None	34	14
Primary	56	23
Secondary	71	30
Tertiary	79	33
Total	240	100
Rice Farming Experience (Years)		
<5	49	20
6 – 10	64	27
10 – 20	91	38
>20	36	15
Total	**240**	**100**

Membership of cooperative group		
Yes	152	63
No	88	37
Total	**240**	**100**
Access to Credit facilities		
Yes	113	47
No	127	53
Total	**240**	**100**
Extension Contact per year		
None		
1 – 3	98	41
4 – 6	82	34
>6	44	18
Total	16	7
	240	**100**
Farm size (ha)		
=1	99	41
1 – 3	116	48
3 – 6	18	8
>6	7	3
Total	**240**	**100**
Type of Labour Used		
Family only	43	18
Hired only	79	33
Both	118	49
Total	**240**	**100**
Purpose **of** production		
Subsistence	51	21
Commercial	189	79
Total	**240**	**100**

Source: *Field survey, 2025*

The data shows a male-dominated respondents pool (79% male vs. 21% female). This aligns with findings by Adebayo and Olagunju (2015), who noted that rice farming in Nigeria is predominantly male-driven due to cultural norms and the labour-intensive nature of farming activities. Women's limited participation may reflect restricted access to land and resources, as reported by Ogunniyi, Olagunju & Adebayo, (2017). This male dominance also aligns with studies by Onyemauwa, (2018) and Adamu, Usman & Aliyu (2022) which reported that male farmers dominate agricultural activities in Northern Nigeria due to cultural and traditional factors and that male farmers often have greater access

to resources and land, which enhances their productivity.

The majority of farmers (17.1%, 37%) are aged 25 – 35 and 36 – 45, with only 4.6% below 25 years. This age bracket is often considered economically active and productive, as younger and middle-aged individuals are more adaptable to modern farming techniques and more physically capable of engaging in labour-intensive activities (Usman, Yakubu & Umar, 2021). This active middle-age group (25–55 years, 82.1%) indicates experience but also a potential future labour shortage. With 83.75% married, family responsibilities likely drive farming efforts, supporting household food security and income. This corroborates Enete and Amusa (2015), who found married farmers more committed to farming for subsistence and commercial purposes. Also, according to Mustapha, Ahmed & Yusuf, (2023), married farmers generally have larger family sizes that can contribute to farm labour, thereby reducing production costs.

Most respondents (44%) have 4–6 family members and 36% have family size of more than six members, suggesting moderate to large household labour availability. This large family size is advantageous for labour availability, which is vital for rice farming operations (Eze, Eze & Okafor, 2017) but may however strain family resources, as noted by Ojo, Ibrahim & Mohammed, (2020). In terms of education level, tertiary education (33%) and secondary education (30%) dominate, indicating a relatively educated farming population. Education enhances adoption of modern techniques, as confirmed by Adebayo, Ogunniyi, & Olagunju (2016) and Oladimeji & Abdulsalam, (2019). Though 14% with no education may face challenges in technical adoption.

Farmers with 10–20 years of experience (38%) predominate, reflecting expertise that boosts productivity (Oluwatusin, 2017; Nwaobiala, 2020). However, 20% with less than 5 years suggest new entrants, possibly driven by government rice production initiatives. 63% belong to cooperatives, which facilitate resource and market access and knowledge sharing (Yakubu & Ugwu, 2018; Ogundele, Adepoju & Oladipo, 2019). Non-members (37%) may face isolation from such benefits. A slim majority (53%) lack credit access, a persistent barrier in Nigerian agriculture (Akinbode, Ojo & Adebayo, 2021). Limited credit access remains a challenge, constraining the ability to invest in improved inputs (Abdullahi, Lawal & Ibrahim, 2023).

A considerable percentage (41%) of the farmers have no extension contact, while 34% have 1–3 visits yearly. Limited extension services hinder technology transfer, as reported by Ogunleye, Oladeji & Ogunniyi, (2018). Frequent extension visits are essential for knowledge dissemination and technical support (Oluwafemi & Adebayo, 2020). Most farms (48%) are 1–3 hectares, typical of smallholder systems in Nigeria (Mgbenka, Mbah & Ezeano, 2016). Only 3% exceed 6 hectares, indicating land scarcity. Both family and hired labour (49%) is common, balancing cost and availability. Hired labour only (33%) reflects commercialization trends (Ojo *et al*., 2020). Commercial production (79%) dominates rice farming in Nasarawa state, aligning with Nigeria's push for rice self-sufficiency (Akinbode, Ojo & Adebayo, 2021), though subsistence (21%) persists for food security.

Table 2: Average Cost and Return Per Hectare of Paddy Rice Farming

S/N	Item	Amount (?)	Percentage of total cost (%)
	Output	**1,300,000**	
	Variable inputs cost		
1	**Seeds**	48,000	6.3
2	Agrochemicals	37,000	4.8
3	Transportation	75,000	9.8
4	Fertilizer	49,000	6.4
5	Labour	220,000	28.7
6	Miscellaneous	170,000	22.2
	Total variable cost (TVC)	**599,000**	**78**
	Fixed inputs		
1	Interest on loans	30,000	3.9
2	Rent on Land	50,000	6.5
3	Depreciation on equipment	88,000	11.5
	Total Fixed Cost (TFC)	**168,000**	**21.9**
	Total cost	**767,000**	
	GM (TR - TVC)	**701,000**	
	NFI (GM - TFC)	**533,000**	
	PI	**0.695**	
	ROI	**69.5%**	
	BCR	**1.7**	

Source: *Field survey, 2025*

The total revenue (TR) of ₦1,300,000 per hectare and total cost (TC) of ₦767,000 yield a net farm income (NFI) of ₦533,000, with a benefit-cost ratio (BCR) of 1.7 and return on investment (ROI) of 69.5%. These metrics indicate profitability, consistent with Adebayo *et al*. (2016), who found rice farming viable in Nigeria's Middle Belt. Labour (28.7%) is the largest variable cost, reflecting labour-intensive practices (Ogunniyi *et al*., 2017). Miscellaneous costs (22.2%) and transportation (9.8%) suggest infrastructural deficits, while seeds (6.3%) and fertilizers (6.4%) indicate moderate input use. However, the high labour cost (28.7% of total cost) remains a critical factor affecting profitability, consistent with the study by Alabi, Yusuf & Bello, (2021). Depreciation on equipment (11.5%) and rent on land (6.5%) highlight capital investment needs. Interest on loans (3.9%) is low, possibly due to limited credit access.

The gross margin (GM) of ₦701,000 and NFI of ₦533,000, with a profitability index (PI) of 0.695, affirm economic viability. The BCR of 1.7 exceeds the threshold of 1, and the ROI of 69.5% surpasses findings by Oluwatusin (2017) in southwest Nigeria (50%), suggesting favourable conditions in Nasarawa.

Sensitivity Analysis of NFI, ROI and BCR of Rice Production in the Study Area

Table 3: Increasing Cost

S/N	% Increase in cost	TC	TR	NFI	BCR	ROI	remark
1	0	767,000	1,300,000	533,000	1.69	69.49	recommended
2	5	805,350	1,300,000	494,650	1.61	61.42	recommended
3	10	843,700	1,300,000	456,300	1.54	54.08	recommended
4	15	882,050	1,300,000	417,950	1.47	47.38	recommended
5	20	920,400	1,300,000	379,600	1.41	41.24	recommended
6	25	958,750	1,300,000	341,250	1.36	35.59	not recommended
7	30	997,100	1,300,000	302,900	1.30	30.38	not recommended
8	35	1,035,450	1,300,000	264,550	1.26	25.55	not recommended
9	40	1,073,800	1,300,000	226,200	1.21	21.07	not recommended
10	45	1,112,150	1,300,000	187,850	1.17	16.89	not recommended
11	50	1,150,500	1,300,000	149,500	1.13	12.99	not recommended

Source: *Field survey, 2025*

Table 4: Decreasing Revenue

S/N	% Fall in TR	TC	TR	NFI	BCR	ROI	remark
1	0	767,000	1,300,000	533,000	1.69	69.49	recommended
2	5	767,000	1,235,000	468,000	1.61	61.02	recommended
3	10	767,000	1,170,000	403,000	1.53	52.54	recommended
4	15	767,000	1,105,000	338,000	1.44	44.07	recommended
5	20	767,000	1,040,000	273,000	1.36	35.59	recommended
6	25	767,000	975,000	208,000	1.27	27.12	not recommended
7	30	767,000	910,000	143,000	1.19	18.64	not recommended
8	35	767,000	845,000	78,000	1.10	10.17	not recommended
9	40	767,000	780,000	13,000	1.02	1.69	not recommended
10	45	767,000	715,000	-52,000	0.93	-6.78	not recommended
11	50	767,000	650,000	-117,000	0.85	-15.25	not recommended

Source: Field survey, 2025

Increasing Cost

As costs rise by 5 – 50%, NFI declines from ₦533,000 to ₦149,500, BCR from 1.69 to 1.13, and ROI from 69.49% to 12.99%. Up to a 20% increase (NFI: ₦379,600, BCR: 1.41, ROI: 41.24%) remains recommendable, but beyond 25%, profitability erodes significantly, this is consistent with studies that link rising input costs to declining profit margins (Omorogiuwa & Udoh, 2023). This sensitivity to cost increases also aligns with Mgbenka *et al*. (2016), who noted smallholders' vulnerability to input price shocks, exacerbated by reliance on imported agrochemicals and fuel.

Decreasing Revenue

A revenue drop by 5 – 50% reduces NFI from ₦533,000 to -₦117,000, BCR from 1.69 to 0.85, and ROI from 69.49% to -15.25%. Up to a 20% fall (NFI: ₦273,000, BCR: 1.36, ROI: 35.59%) is viable, but beyond 25%, losses emerge. This indicates the vulnerability of rice production to market price fluctuations (Nwafor, Ezeh & Onwuka, 2022) and market price volatility risks, as documented by Akinbode *et al*. (2021), where poor pricing and market access depress returns.

Constraints to Rice Farming in Nasarawa State

Table 4. Constraints faced by rice farmers in the study area

S/N	Constraints	Scores							
		1st	2nd	3rd	4th	5th	Total	Average	Rank
1	Inadequate capital	14,696	3,666	803	552	462	20,179	84.08	1st
2	Lack of processing and storage facilities	14,872	2,652	1,679	552	396	20,151	83.96	2nd
3	Herders Invasion	13,992	3,120	1,533	966	396	20,007	83.36	3rd
4	High cost of transportation	13,464	2,964	1,752	1,311	396	19,887	82.86	4th
5	Poor pricing of produce	10,824	4,758	3,504	345	198	19,629	81.79	5th
6	Poor access to credit	9,856	6,006	2,263	828	528	19,481	81.17	6th
7	High cost of labour	9,064	5,928	2,336	1,242	726	19,296	80.40	7th
8	Irrigation problem	7,832	7,488	2,263	1,173	462	19,218	80.08	8th
9	Poor Mechanization	8,888	4,992	2,628	2,001	660	19,169	79.87	9th
10	Scarcity of land	8,624	5,226	3,285	1,104	924	19,163	79.85	10th

11	Flooding of farm land	6,864	4,836	2,993	2,001	1,980	18,674	77.81	11th
12	Poor extension services	4,752	5,226	4,599	3,312	528	18,417	76.74	12th
13	Unfavourable climatic conditions	6,688	3,198	2,190	3,450	2,838	18,364	76.52	13th
14	High cost of seeds	5,896	3,510	2,993	3,381	2,508	18,288	76.20	14th
15	Poor access to markets	4,840	4,056	3,212	3,519	2,508	18,135	75.56	15th
16	Poor road infrastructure	5,368	2,886	3,504	3,243	3,102	18,103	75.43	16th
17	Pest and disease infestation	4,224	2,886	3,723	3,795	3,234	17,862	74.43	17th
18	High cost of Agrochemicals	3,520	3,978	3,212	4,347	2,772	17,829	74.29	18th
19	Theft	1,144	3,510	3,796	4,209	4,554	17,213	71.72	19th
20	Fire outbreaks	2,728	1,794	1,606	5,244	5,808	17,180	71.58	20th
21	Lack of technical expertise	1,848	1,326	292	7,659	5,742	16,867	70.28	21st

Source: Field survey, 2025

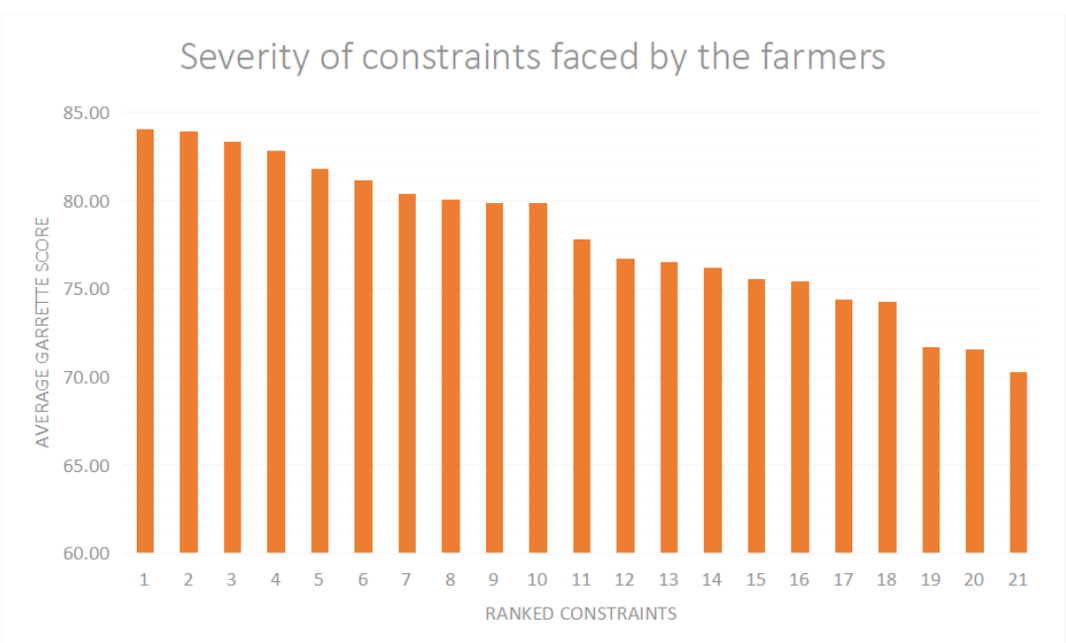

Fig 1: Constraints as ranked in table 4 *Source: Field survey, 2025.*

Constraints are ranked by average scores, with inadequate capital (84.08) topping the list, followed by lack of processing/storage facilities (83.96) and herder invasion (83.36). These align with broader Nigerian agricultural challenges. The high scores of inadequate capital reflect limited credit access (53% lack it), hindering input acquisition (Ogunleye *et al*., 2018). This aligns with findings by Odoemelam, Anozie & Nwankor. (2019), who identified limited financial resources as a critical barrier to productivity enhancement.

Lack of processing and storage facilities (ranked 2nd) results in post-harvest losses and low market prices, corroborating the findings of Akinwale and Adebayo (2021). Post-harvest losses, estimated at 20–40% in Nigeria (Ajah, Nmadu & Aliyu, 2018), reduce marketable output. Herder invasions (ranked 3rd) disrupt farming activities and cause crop damage, consistent with observations in other agrarian regions (Ogundele & Falola, 2020). Herder invasion disrupt production and is a growing issue in the Middle Belt (Enete & Amusa, 2015). Poor road infrastructure (rank 16, 75.43) inflates transportation costs (9.8% of TVC), as noted by Ogundele *et al*. (2019). Poor Pricing (ranked 5th) depress revenue (Akinbode *et al*., 2021). Poor credit access ranked 6th (81.17) underscores financial constraints, limiting scale and modernization (Ojo *et al*., 2020). 7–21. Other Constraints: High labour costs, irrigation issues, mechanization deficits, and pests/diseases (74.43) reflect systemic underinvestment and climatic risks (Adebayo & Olagunju, 2015).

Conclusion

This study concludes that rice production in Nasarawa State, Nigeria, is a profitable venture despite the numerous challenges faced by farmers. The analysis shows a substantial net farm income of ₦533,000 per hectare, a return on investment of 69.5%, and a benefit-cost ratio of 1.7, indicating that rice farming remains economically viable. However, the sensitivity analysis reveals that profitability is highly susceptible to increases in production costs and decreases in output prices. Specifically, profitability becomes questionable when costs rise beyond 20% or revenue falls beyond 20%. These findings underscore the need for strategic interventions to stabilize input prices and market conditions to safeguard farmers' income. The study also identifies significant challenges affecting rice production, including inadequate capital, poor processing and storage facilities, herder invasions, and high transportation costs. Addressing these constraints is essential to enhance productivity and maintain the profitability of rice farming. Moreover, promoting mechanization and improving access to credit facilities will empower farmers to optimize production and reduce operational risks. Overall, sustainable rice production in Nasarawa State requires a multi-faceted approach involving policy reforms, infrastructure development, and capacity building among smallholder farmers.

Recommendations

Based on the findings, the following recommendations are proposed to enhance the profitability, resilience, and sustainability of rice production in Nasarawa State:

1. Government and financial institutions should expand low-interest loan schemes (e.g., Anchor Borrowers' Program) and provide subsidies on key inputs like fertilizers, seeds, and labour-saving equipment to address capital constraints (ranked 1st, 84.08) and high labour costs (ranked 7th, 80.40), enabling farmers to invest in productivity-enhancing resources.
2. Subsidized rice processing and storage facilities at the community level should be established to reduce post-harvest and address the 2nd-ranked constraint (83.96), thereby stabilizing supply and improving farmers' income.
3. There should be implementation of conflict resolution mechanisms, designation of grazing zones to curb herder invasions of crop farms (ranked 3rd, 83.36), and upgrading of rural road

networks alongside provision of subsidized transport services to lower transportation costs (ranked 4th, 82.86; 9.8% of total cost) and ensure more accessible markets.

4. Price support mechanisms, such as minimum guaranteed prices or buffer stock systems should be introduced to mitigate poor pricing (ranked 5th, 81.79) and protect farmers from revenue drops exceeding 20%, as indicated by sensitivity analysis.
5. Funding and staffing for extension programs should be increased to reach the 41% of farmers without contact and also for promoting modern techniques to boost productivity and resilience against constraints like irrigation problems (ranked 8th, 80.08) and mechanization challenges (ranked 9th, 79.87).

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