

Competitiveness and Comparative Advantage of Wheat (*Triticum aestivum*) Production in Kano State, Nigeria

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Abstract

This study assessed the competitiveness, comparative advantage, and policy effects of wheat production in Kano State, Nigeria. A multistage sampling procedure was employed to select 274 wheat farmers from three major wheat-producing Local Government Areas: Kura, Bunkure, and Bagwai. Primary data were collected using a structured questionnaire. Competitiveness and comparative advantage were evaluated using private and social profitability measures, Private Cost Ratio (PCR), Domestic Resource Cost (DRC), Nominal Protection Coefficients on Output (NPCO) and Input (NPCI), Effective Protection Coefficient (EPC), and sensitivity analysis. The results revealed that wheat production generated positive private profit (₦580,823.92 ha⁻¹) and social profit (₦319,009.74 ha⁻¹), indicating that the enterprise was both financially profitable and economically efficient. The estimated PCR (0.44) and DRC (0.58) showed that wheat production was competitive and possessed a comparative advantage. The NPCO (1.27), NPCI (0.98), and EPC (1.36) indicated that existing agricultural policies provided positive incentives to producers. Sensitivity analysis further showed that wheat production remained competitive under moderate changes in output prices, production levels, and exchange rates; although substantial declines in output prices reduced competitiveness. The study concludes that wheat production in Kano State has strong potential to support Nigeria's wheat import substitution strategy. It recommends sustained investment in irrigation infrastructure, improved seed systems, agricultural mechanization, extension services, and well-targeted policy interventions to enhance the long-term competitiveness and sustainability of domestic wheat production.

Keywords: Competitiveness, Comparative Advantage, Wheat, Sensitivity Analysis, Kano State, Nigeria.

Introduction

Wheat (*Triticum aestivum* L.) is one of the world's most important cereal crops and contributes about 20% of the calories and protein consumed by the global population. Beyond its role as a staple food, wheat serves as a major raw material for flour milling and food-processing industries, making it indispensable to global food and nutrition security (Shiferaw et al., 2013). Rising population growth, urbanization, and changing food preferences have continued to increase global wheat demand, particularly in developing countries where consumption is expanding more rapidly than domestic production (Mason et al., 2015).

In Nigeria, wheat is the second most important cereal for industrial food processing after maize and is widely consumed in the form of bread, pasta, noodles, biscuits, and other confectioneries. However, domestic production has consistently remained far below national demand despite the country's favorable agro ecological conditions for irrigated wheat cultivation, particularly in the Sudan and Northern Guinea Savanna zones. Between 2010 and 2020, wheat consumption increased from approximately 3.58 million metric tonnes (MT) to about 5.55 million MT, while domestic production remained below 100,000 MT annually, making Nigeria one of the largest wheat-importing countries in sub-Saharan Africa (USDA Foreign Agricultural Service [USDA-FAS], 2021). Continued dependence on wheat imports places considerable pressure on foreign exchange reserves and exposes the country to fluctuations in global commodity prices and supply-chain disruptions (Liverpool Tasie et al., 2023).

To reduce import dependence and strengthen national food security, the Federal Government of Nigeria has implemented several programmes aimed at increasing domestic wheat production, including irrigation development, dissemination of improved wheat varieties, fertilizer support, mechanization, and agricultural credit interventions. Although these initiatives have contributed to improvements in wheat production, productivity remains constrained by inadequate irrigation infrastructure, high input costs, limited access to improved seed, poor extension services, climate variability, and limited access to affordable finance. These constraints continue to reduce farm productivity and weaken the competitiveness of domestic wheat production relative to imported wheat (USDA-FAS, 2025).

Assessing the competitiveness and comparative advantage of domestic wheat production is therefore essential for evaluating the effectiveness of existing agricultural policies and determining whether local production can efficiently substitute for imports. The Policy Analysis Matrix (PAM) developed by Monke and Pearson (1989) provides a comprehensive framework for evaluating private profitability, comparative advantage, and the effects of government policies on agricultural production systems. Unlike conventional profitability analysis, PAM simultaneously measures financial efficiency and economic efficiency, thereby providing evidence for informed policy formulation.

Although several studies have analysed the economics and profitability of wheat production in Nigeria, limited empirical evidence exists on its competitiveness, comparative advantage, and policy effects in Kano State using the Policy Analysis Matrix framework. Kano State is one of Nigeria's leading wheat-producing states and plays an important role in the country's dry-season wheat production. However, there is inadequate empirical evidence on whether existing policy interventions provide sufficient incentives to enhance competitiveness and efficient resource utilization among wheat farmers. This study addresses this gap by evaluating the competitiveness, comparative advantage, and policy effects of wheat production in Kano State using the Policy Analysis Matrix approach.

Statement of the Problem

Despite substantial public investment in promoting wheat production, Nigeria continues to depend heavily on imports to meet domestic demand. This persistent production-consumption gap raises concerns about the competitiveness of locally produced wheat and the efficiency of existing agricultural policies. Previous studies have largely focused on profitability and production constraints, with limited attention to comparative advantage and policy impacts using the Policy Analysis Matrix framework, particularly in Kano State. Consequently, policymakers lack sufficient empirical evidence to determine whether current policy interventions enhance farmers' competitiveness and promote efficient resource allocation. Addressing this knowledge gap is essential for designing effective policies that will improve domestic wheat production, reduce import dependence, and strengthen national food security.

The broad objective of this study was to assess the competitiveness and comparative advantage of wheat production in Kano State, Nigeria. While the specific objectives were to:

1. determine the competitiveness of wheat production in Kano State;
2. assess the comparative advantage of wheat production;
3. examine the effects of agricultural policies on wheat production; and
4. evaluate the sensitivity of wheat production to changes in output prices, production levels, and exchange rates in Kano State.

Literature Review

Conceptual Framework:

Competitiveness and Comparative Advantage

Competitiveness refers to the ability of a production system to produce a commodity profitably under prevailing market conditions while efficiently utilizing available resources. In agricultural economics, competitiveness is assessed using market (private) prices and reflects producers' capacity to compete with imported products without requiring excessive policy support. Within the Policy Analysis Matrix (PAM), competitiveness is measured by the Private Cost Ratio (PCR), where a PCR value less than one indicates that producers can cover domestic factor costs and remain competitive under existing market conditions (Monke & Pearson, 1989). Competitiveness therefore provides useful information for evaluating the financial viability of agricultural enterprises and the effectiveness of existing market policies.

Comparative Advantage

Comparative advantage describes the ability of an economy to produce a commodity at a lower opportunity cost than alternative producers by utilizing domestic resources efficiently. Unlike competitiveness, comparative advantage is evaluated using social (economic) prices, which eliminate distortions created by taxes, subsidies, and other policy interventions. Under the PAM framework, comparative advantage is measured using the

Domestic Resource Cost (DRC) ratio. A DRC value below one indicates efficient use of domestic resources and suggests that local production is economically preferable to importation, whereas a value greater than one indicates a comparative disadvantage (Monke & Pearson, 1989; Masters & Winter-Nelson, 1995).

Policy Analysis Matrix (PAM)

The Policy Analysis Matrix (PAM), developed by Monke and Pearson (1989), is a widely used analytical framework for evaluating the competitiveness, comparative advantage, and policy effects of agricultural production systems. The framework compares private (market) and social (economic) revenues and costs to determine financial profitability, economic efficiency, and the extent of policy distortions affecting producers. PAM generates several policy indicators, including the Private Cost Ratio (PCR), Domestic Resource Cost (DRC), Nominal Protection Coefficient on Output (NPCO), Nominal Protection Coefficient on Input (NPCI), and Effective Protection Coefficient (EPC). These indicators provide valuable evidence for assessing whether existing agricultural policies improve producers' competitiveness and promote efficient resource allocation (Monke & Pearson, 1989).

The concepts of competitiveness and comparative advantage are fundamental to understanding agricultural production systems and policy effectiveness. Competitive advantage refers to the ability of a producer to generate profit at existing market prices, reflecting the actual financial viability of an enterprise under current policies and market conditions. In contrast, comparative advantage measures the efficiency of resource use at social or shadow prices, indicating whether a country should produce a good based on its opportunity cost of resources (Monke & Pearson, 1989).

According to Monke and Pearson (1989), as cited in recent agricultural policy literature (Aya & Saad, 2023), the Policy Analysis Matrix (PAM) framework distinguishes between these two concepts through separate accounting at private (market) and social (efficiency) prices. A commodity may be privately profitable (competitive) but socially unprofitable (lacking comparative advantage) if government policies such as subsidies or trade protection artificially inflate domestic prices. Conversely, a commodity may have comparative advantage but lack competitiveness if policy distortions or market failures impede its profitability.

Theoretical Framework

This study is anchored on Ricardo's Theory of Comparative Advantage, first advanced by David Ricardo in 1817. The theory postulates that a country should specialize in the production of commodities for which it has the lowest opportunity cost relative to other countries, even when it does not possess an absolute production advantage (Ricardo, 1817). The theory argues that specialization based on comparative advantage enhances production efficiency, promotes efficient resource allocation, and improves overall economic welfare through trade.

The theory provides the conceptual basis for evaluating whether domestic production utilizes available resources more efficiently than alternative uses or imported commodities. In agricultural economics, comparative advantage is commonly assessed by comparing the economic costs of domestic resource use with the value added generated under undistorted market conditions. This principle forms the foundation of the Policy Analysis Matrix (PAM), where the Domestic Resource Cost (DRC) ratio is used to determine whether a production system possesses a comparative advantage. A DRC value less than one indicates efficient utilization of domestic resources and suggests that local production is economically competitive with imports, whereas a value greater than one indicates a comparative disadvantage (Monke & Pearson, 1989).

The theory is particularly relevant to this study because it provides the economic rationale for assessing whether wheat production in Kano State can compete efficiently with imported wheat under existing production conditions and policy environments. Consequently, Ricardo's Theory of Comparative Advantage provides an appropriate theoretical foundation for evaluating the competitiveness, comparative advantage, and policy effects of wheat production using the Policy Analysis Matrix framework.

Research Gap

Previous studies on wheat production in Nigeria have largely focused on profitability, production efficiency, commercialization, technology adoption, and production constraints. However, limited empirical evidence exists on the competitiveness, comparative advantage, and policy effects of wheat production using the Policy Analysis Matrix (PAM), particularly in Kano State. Consequently, there is inadequate information on whether wheat production in the state is financially competitive and economically efficient under existing policy and market conditions. This study addresses this gap by applying the Policy Analysis Matrix to evaluate the competitiveness, comparative advantage, and policy effects of wheat production in Kano State, thereby providing evidence to support policies for improving domestic wheat production and reducing import dependence.

Contribution of This Study

This study addresses these gaps by providing the first comprehensive PAM-based analysis of wheat competitiveness and comparative advantage in Kano State, Nigeria, using primary data collected in 2023. By calculating PCR, DRC, NPCO, NPCI, and EPC indicators, and conducting sensitivity analysis under varying price, quantity, and exchange rate scenarios, this study offers evidence-based insights for policymakers seeking to balance import substitution objectives with efficient resource allocation and sustainable farmer livelihoods.

Methodology

The study Area

The study was conducted in Kano State, located in the northwestern region of Nigeria between latitudes 9°30' and 12°37' N and longitudes 7°40' and 9°29' E. Kano State is one of

the leading agricultural and commercial states in the country, comprising 44 Local Government Areas (LGAs) with a land area of approximately 20,131 km² (National Bureau of Statistics [NBS], 2022). The state has an estimated population of over 15 million people, making it the most populous state in Nigeria (National Population Commission [NPC], 2023). Agriculture is the dominant economic activity, with major crops including wheat, rice, maize, sorghum, millet, groundnut, soybean, tomato, onion, pepper, and other vegetables. Livestock production, fisheries, and agro-processing also contribute significantly to the state's economy (Kano State Bureau of Statistics [KNBS], 2023).

Kano State lies within the Sudan Savannah agro ecological zone and is characterized by distinct wet and dry seasons influenced by the Inter-Tropical Discontinuity (ITD). Annual rainfall ranges from 600 to 1,200 mm, while the mean annual temperature varies between 26°C and 32°C, providing favorable conditions for irrigated dry-season wheat production (Murtala et al., 2015). The state possesses extensive irrigation infrastructure, including major dams and river basins that support year-round agricultural activities, making it one of Nigeria's principal wheat-producing states. These favorable agro ecological conditions and the concentration of wheat farmers justified the selection of Kano State for this study.

Sampling Procedure

A multi-stage sampling procedure was employed for the study. The first stage involved random sampling by balloting to select three Local Government Areas (LGAs) out of seven major wheat-producing LGAs proposed for the study. The LGAs selected were Kura, Bunkure, and Bagwai. The second stage involved the random selection of four farming communities from each LGA, giving a total of 12 farming communities. The third stage involved the application of the Yamane (1967) formula for sample size determination and proportionate sampling to select the appropriate number of wheat farmers per farming community.

The following expression was used to determine the sample size:

$$= \frac{N}{1+(N)e^2} \dots \dots \dots (1)$$

Where: n = sample size

N = Total number of Jth wheat farmers in all 12 farming communities

e² = Confidence level (0.05)².

While for the proportionate sampling the expressions were as follows;

$$n = \frac{X}{D} * N \dots \dots \dots (2)$$

Where: n = sample size of Jth wheat farmers selected per community

X = Number of Jth wheat farmers in a farming community

D = Total number of Jth wheat farmers in all 12 farming communities

N = Recommended sample size by Yamane's formula.

Method of Data Collection

Primary and secondary data were used for the study. Primary data were collected with the aid of a structured questionnaire administered to the sampled wheat farmers by trained

enumerators. Data collected included socio-economic variables, inputs and output data on wheat production, domestic market price of output per kg, and costs of various inputs used such as fertiliser, seed, land, labour, fuel, water, capital, and agro-chemicals.

Secondary data on international market prices, Free On Board (FOB) and Cost, Insurance and Freight (CIF) of wheat output per kg, unit prices of all tradable inputs, and exchange rates for computing social prices were obtained from the International Fund for Agricultural Development (IFAD), the Central Bank of Nigeria (CBN), and the World Bank.

Analytical Technique: Policy Analysis Matrix (PAM)

The Policy Analysis Matrix is a product of two accounting identities (Table 1). The first identity defines profitability as the difference between revenues and costs, measured in either private or social terms. The second identity measures the effects of divergence (distorting policies and/or market failures) as the difference between observed private values and social values that would prevail if divergences were removed.

Table 1: Disaggregated View of Policy Analysis Matrix

	Revenue	Input Cost		Profit
		Tradable inputs	Domestic Factors	
Private	$P^d Q^d$	$\sum P_i^d Q_i^d$	$\sum W_j^d I_j^d$	D
Social	$P^w Q^d$	$\sum P_i^w Q_i^d$	$\sum W_j^w I_j^d$	H
Policy Transfer	I	J	K	L

Source: Monke and Pearson (1989) as cited by Aya and Saad (2023).

The data in the first row of the PAM framework provide a measure of private profitability, defined as the difference between observed revenue and cost. This captures the competitiveness of the agricultural system given current technologies, input and output prices, and policy transfers (Mudhi & Mohammad, 2012).

Private profit (D) was calculated as:

$$D = A - (B + C)$$

Where:

$$A) = P^d Q^d$$

P^d = Observe domestic market price per unit of output

Q^d = Average quantity of output

$$B) = \sum P_i^d Q_i^d$$

P_i^d = Observe domestic market price per unit of tradable input i used

Q_i^d = Average quantity of tradable input i at domestic level

$\sum$ = Summation across all private tradable inputs i use

$$C) = \sum W_j^d I_j^d$$

W_j^d = Domestic market price per unit of domestic factor j use

I_j^d = Average quantity of domestic factor j use

$\sum$ = Summation across all private primary domestic factors use.

The second row of the PAM measures social profit, which is calculated at shadow prices. Social profit reflects social opportunity costs and measures efficiency and comparative advantage. A positive social profit indicates that the system uses scarce resources efficiently and contributes to national income (Keyser, 2006).

Social profit (H) was calculated as:

$$H = E - (F + G) \dots\dots\dots(4)$$

Where

H = Social Profit

$$E = P^w Q^d$$

P^w = World price per unit of output

Q^d = Average quantity of output

$$F = \sum P_i^w Q_i^d$$

P_i^w = World price per unit of tradable input i use

Q_i^d = Average quantity of tradable input i use at domestic level

$\sum$ = Summation across all social tradable inputs use

$$G = \sum W_j I_j^d$$

W_j^r = Rural factor market price per unit of domestic factor j use

I_j^d = Average quantity of domestic factor j use

$\sum$ = Summation across all social factors j use.

The second accounting identity, which is the third row of the matrix represents transfers that come into play due to policy-induced market distortions. This captures the divergences between the first row (measured at private prices) and the second row (measured at social prices). The difference between private and social values of costs, revenues and profits can be explained by policy interventions (Esmaeili, 2008).

$$L = I - (J + K) \dots\dots\dots(5) \text{ Where}$$

L = Net transfers that measures the degree of government intervention

v. = A – E (Output transfer that measures subsidies on output)

vi. = B – F (Inputs transfer that measures subsidies on inputs)

vii. = C – G (Factor transfer that measures subsidies on primary domestic factor)

The third row of the matrix represents transfers that come into play due to policy-induced market distortions. This captures the divergences between the first row (measured at private prices) and the second row (measured at social prices). Net transfers (L) were calculated as:

$$L = I - (J + K)$$

Policy Analysis Matrix Indicators

The private cost ratio (PCR) is used in measuring competitiveness. It shows the private efficiency of the Agricultural system and is an indication of how much one can afford to pay domestic factors (including a normal return to capital) and still remain competitive.

$$PCR = \frac{C}{A-B} \dots\dots\dots(6)$$

When $PCR > 1$ indicates that the resource cost is greater than the value added and thus, the wheat production is not competitive.

If $PCR < 1$ indicates that the value added is greater than the resource cost thus, the wheat production is competitive.

If $PCR = 1$ indicates the breakeven point.

Domestic Resource Cost (DRC).

The domestic resource cost (DRC) is a measure of relative efficiency of domestic producers by comparing the opportunity cost of domestic producers to the value generated by the product. The ratio can be used to compare different economic activities in terms of social cost of domestic resource employed in earning or saving a unit of foreign exchange. The relationship between DRC and comparative advantage is straight forward;

$$DRC = \frac{G}{E-F} \dots\dots\dots(7) \quad DRC < 1 \text{ the}$$

wheat producers have competitive advantage and enjoys protection.

$DRC > 1$ it signifies that the country has no comparative advantage in production of analyzing goods.

When $DRC = 1$ the economy neither gains, nor saves foreign exchange through domestic production.

Nominal Protection Coefficient (NPC)

This was used to determine the relationship between the market price and the shadow price of the wheat production. This was calculated for the output and input.

Nominal Protection Coefficient on Output (NPCO)

The NPCO shows how much domestic prices differ from social prices and it is calculated by dividing the revenue in private prices (A) by the revenue in social prices (E).

$$NPCO = \frac{A}{E} \dots\dots\dots(8)$$

If $NPCO > 1$ Shows subsidies on output.

If $NPCO < 1$ Shows absences of subsidies on output.

If $NPCO = 1$ reveals the absence of market failures or the absence of intervention in wheat production.

Nominal Protection Coefficient on Input (NPCI)

The NPCI shows how much domestic prices of tradable inputs differ from their social prices. This ratio indicates the impact of policy transfers that cause a divergence between the two prices. The NPCI on tradable inputs in wheat production is therefore defined as private price of input (B) divided by social price of input (F).

$$NPCI = \frac{B}{F} \dots\dots\dots(9)$$

If $NPCI > 1$ Shows absence of subsidies on Input.

If $NPCI < 1$ Shows presences of subsidies on Input.

Effective Protection Coefficient (EPC)

The effective protection coefficient (EPC), another indicator of incentives, was used to measure the degree of policy transfer from product market-output and tradable-input-policies. EPC nets out the impact of protection on inputs and outputs, and reveals the degree of protection accorded to the value added process in the production activity of the relevant commodity.

$$EPC = \frac{A-B}{E-F} \dots\dots\dots(10)$$

EPC > 1 means the wheat farmers are protected through policy intervention.

EPC < 1 means the wheat farmers are not protected through policy interventions.

Sensitivity Analysis

Because the PAM framework is a static model that cannot capture changes in prices, productivity, or policy parameters (Adegbite et al., 2014), sensitivity analysis was carried out. Indicators varied included domestic price of output (increase and decrease by 10% and 20%), output quantity (increase and decrease by 10% and 20%), and exchange rate (increase and decrease by 10% and 20%). This followed the approach of Ude et al. (2013), who used 10% increases and decreases in revenue and exchange rates for sensitivity analysis of rice processing and marketing in Ebonyi State.

Results and Findings

Policy Analysis Matrix Elements

Table 2: Computation of Policy Analysis Matrix Elements for Wheat Producers

	Revenue (₦)	Tradable Inputs(₦)	Domestic factors(₦)	Profit(₦)
Private	1,265,097.90	231,134.53	453,139.45	580,823.92
Social	993,230.70	234,673.44	439,547.52	319,009.74
Policy Transfer	271,867.20	-3,538.91	13,591.93	261,814.18

Source: Authors computation, 2023.

Table 2 shows that private profit (₦ 580,823.92) is positive, indicating that wheat production is financially viable for farmers under current market conditions. Social profit (₦319,009.74) is also positive, confirming that wheat production efficiently utilises domestic resources and has a comparative advantage in the region. The positive revenue divergence (₦271,867.20) indicates that private prices are higher than social prices, suggesting government policies and subsidies have positively influenced wheat production. The negative divergence in tradable input costs (₦-3,538.91) suggests that wheat farmers purchase inputs at lower cost than international prices, confirming the presence of subsidies on fertilisers, seeds, and agrochemicals.

Policy Analysis Matrix Indicators

Table 3 summarises the key economic indicators measuring the impact of government interventions on wheat production.

Table 3: Policy Analysis Matrix Indicators

Indicators	PCR	DRC	NPC(I)	NPC(O)	EPC
Equation	$C/(A-B)$	$G/(E-F)$	B/F	A/E	$(A-B)/(E-F)$
Values	0.44	0.58	0.98	1.27	1.36

Source: Authors' computation, 2023

Sensitivity Analysis Results

The sensitivity analysis explored how wheat farmers respond to changes in market conditions. Tables 4, 5, and 6 present the results.

Table 4: Impact of Domestic Market Price Changes (Increase and Decrease by 10% and 20%)

Variables	PCR	DRC	NPC(O)	NPC(I)	EPC
Baseline	0.44	0.58	1.27	0.98	1.36
+10% Increase	0.39	0.51	1.27	0.98	1.35
+20% Increase	0.35	0.46	1.27	0.98	1.34
-10% Decrease	0.50	0.50	1.27	0.98	1.38
-20% Decrease	0.75	0.58	1.27	0.98	1.39

Source: Authors' computation, 2023

When domestic wheat prices increase by 10% and 20%, competitiveness (PCR) improves from 0.44 to 0.39 and 0.35, respectively. When prices drop by 10% and 20%, PCR deteriorates to 0.50 and 0.75, showing that price reductions significantly affect competitiveness.

Table 5: Impact of Changes in Production Quantity (Increase and Decrease by 10% and 20%)

Scenario	PCR	DRC	NPCO	NPCI	EPC
Baseline	0.44	0.58	1.27	0.98	1.36
+10% Increase	0.39	0.58	1.40	0.98	1.53
+20% Increase	0.35	0.58	1.53	0.98	1.70
-10% Decrease	0.50	0.58	1.15	0.98	1.20
-20% Decrease	0.75	0.58	1.02	0.98	1.03

Source: Authors' computation, 2023

Increasing wheat output by 10% and 20% improves competitiveness (PCR drops from 0.44 to 0.39 and 0.35, respectively), confirming that higher yields enhance profitability. A 20% decrease in production leads to a weaker competitive position (PCR = 0.75), implying that low productivity threatens profitability.

Table 6: Impact of Exchange Rate Changes (Increase and Decrease by 10% and 20%)

Variables	PCR	DRC	NPC(O)	NPC(I)	EPC
Baseline	0.44	0.58	1.27	0.98	1.36
+10% Increase	0.44	0.49	1.17	0.90	1.26
+20% Increase	0.44	0.35	1.09	0.83	1.16
-10% Decrease	0.44	0.83	1.16	1.40*	1.46
-20% Decrease	0.44	0.84	1.54	1.20*	1.64

Source: Authors' computation, 2023

When the naira appreciates (strengthens by 10% or 20%), farmers face higher costs for imported inputs, reducing competitiveness. A weaker naira (depreciation by 10% or 20%) results in higher wheat prices, benefiting farmers but increasing consumer costs.

Discussion of Findings

Profitability and Competitiveness (Private Prices)

The positive private profit (₦580,823.92) indicates that wheat production in Kano State is financially viable under current market conditions. This finding aligns with the recent study by Ibrahim et al. (2025) in neighbouring Jigawa State, which reported a private profit of ₦619,390 per hectare. Both studies confirm that, given existing input subsidies (such as fertiliser and improved seeds) and output price supports, smallholder farmers find wheat cultivation profitable. The Private Cost Ratio (PCR) of 0.44 further confirms strong competitiveness. This value is lower (better) than the PCR of approximately 0.50 reported for Indonesian soybeans by Dewi and Yulianti (2021), suggesting that Kano wheat farmers face relatively lower domestic factor costs compared to value added. The PCR of 0.44 means that for every Naira of value added (revenue minus tradable input costs), farmers spend only 44 Kobo on domestic factors (land, labour, capital), leaving a 56% margin for profit and risk coverage.

Comparative Advantage and Social Efficiency (Social Prices)

The positive social profit (₦319,009.74) and Domestic Resource Cost (DRC) of 0.58 demonstrate that wheat production in Kano State possesses a genuine comparative advantage. This means that even when subsidies and protections are removed and prices reflect true opportunity costs, domestic wheat production generates more value than the cost of the domestic resources consumed. The DRC of 0.58 is slightly higher than the 0.52 reported for Jigawa State by Ibrahim et al. (2025) but remains well below the threshold of 1.0, indicating that Kano producers are slightly less efficient than their Jigawa counterparts, yet still efficient in absolute terms. This comparative advantage likely stems from Kano's extensive irrigation infrastructure (over 20 dams providing irrigation water) and historical agricultural specialisation, which have lowered the social opportunity cost of land and labour for wheat cultivation relative to other economic activities (KNSG, 2018).

Policy Effects and Protection Indicators

The Nominal Protection Coefficient on Output (NPCO) of 1.27 indicates that domestic wheat prices are 27% higher than comparable world prices. This confirms active government protection of domestic producers, likely through import tariffs, import quotas, or direct price support mechanisms. This finding is consistent with the NPCO of 1.56 reported by Ibrahim et al. (2025) for Jigawa State, though the lower value in Kano suggests either less policy distortion or better integration with market prices. The Nominal Protection Coefficient on Input (NPCI) of 0.98 indicates that farmers pay slightly less (2% subsidy) for tradable inputs (fertiliser, seeds, fuel) than world market prices. The negative policy transfer on tradable inputs (-₦3,538.91) in Table 2 confirms this modest subsidy. This aligns with recent government programmes such as NAGS-AP, which provided 50-75% subsidies on seeds and fertilisers between 2022 and 2025.

The Effective Protection Coefficient (EPC) of 1.36 indicates that the value-added process (output value minus tradable input costs) is 36% higher under current policies than under free market conditions. This net positive protection explains why private profit (₦580,823.92) substantially exceeds social profit (₦319,009.74). The difference (₦261,814.18) represents the net policy transfer to wheat farmers.

Sensitivity to Market Changes

The sensitivity analysis reveals that wheat competitiveness is asymmetrically vulnerable to negative shocks. A 20% decline in domestic output price raises the PCR from 0.44 to 0.75, substantially eroding competitiveness. This suggests that current policy protections, while beneficial, may have created a cost structure that would become uncompetitive under significant price liberalisation. By contrast, a 20% price increase improves PCR to 0.35, offering only marginal additional competitive gains, indicating diminishing returns to price supports beyond current levels.

Yield improvements demonstrate stronger and more sustainable effects on competitiveness than price supports. A 20% increase in production quantity improves the DRC from 0.58 to 0.46 a more substantial efficiency gain than any price-induced improvement. This finding supports the recent strategic shift in Nigerian agricultural policy towards productivity-enhancing investments (such as NAGS-AP's emphasis on improved seeds and digital extension) rather than solely relying on price and trade protections (Federal Ministry of Information, 2025).

Exchange rate fluctuations present a double-edged sword. Naira depreciation (weakening) improves the NPCO (1.54 at -20% exchange rate change), benefiting farmers through higher effective output prices. However, the NPCI rises above 1.0 (1.20 at -20%), indicating that input costs rise faster than output benefits under extreme depreciation, squeezing net margins. This complexity explains why the DRC remains relatively stable across exchange rate scenarios (0.58 baseline to 0.84 at -20%), as output and input effects partially offset each other.

Conclusion

This study analysed the competitiveness and comparative advantage of wheat production in Kano State, Nigeria, using the Policy Analysis Matrix (PAM) framework. The results indicate that wheat production is profitable at private prices and has a comparative advantage, meaning it efficiently utilises domestic resources. Government policies, including input subsidies, price support for wheat, and trade protection, have positively influenced production. However, wheat farmers still face challenges such as high domestic factor costs, market volatility, and reliance on subsidies. The sensitivity analysis shows that wheat farmers remain competitive but are vulnerable to price drops and policy shifts.

Recommendations

- Based on the findings of this study, the following recommendations are proposed. Sustain but gradually rationalize output price support programmes. The positive NPCO (1.27) confirms that current price protections benefit farmers. Policymakers should gradually transition from direct price supports to productivity linked incentives that reward efficiency rather than simply subsidizing production.
- prioritize yield-enhancing investments over further price protections. The sensitivity analysis demonstrates that a 20% increase in yield improves competitiveness (DRC improves from 0.58 to 0.46) more effectively than a 20% price increase (DRC unchanged at 0.58). Government should invest in expanded irrigation infrastructure, access to high-yielding wheat seed varieties, mechanisation services, and agricultural extension services.
- Maintain input subsidy programs but improve targeting efficiency. The NPCI of 0.98 and negative input policy transfer (-N3,538.91) confirm that current input subsidies reduce production costs. Building on successful models like the NAGS-AP digital registration system, subsidies should be delivered through transparent, verifiable channels.
- Stabilize foreign exchange policies to reduce input cost volatility. Sensitivity analysis reveals that extreme exchange rate depreciation raises NPCI to 1.20, effectively eliminating input subsidies. The Central Bank of Nigeria should consider preferential exchange rates for agricultural input imports and encourage domestic production of fertilizers, seeds, and agrochemicals.
- Encourage private sector investment in local wheat processing and value addition. Government should provide incentives (tax breaks, low-interest loans, infrastructure support) for private sector actors to establish local milling, storage, and processing facilities, creating stable off-take agreements for farmers.
- Conduct regular PAM-based competitiveness assessments. The Federal Ministry of Agriculture and state agricultural development programmes should institutionalise biennial competitiveness assessments using the PAM framework to guide evidence-based policy adjustments.
- Expand comparative PAM research across other wheat-producing states. Similar PAM analyses should be conducted in Jigawa, Kebbi, Bauchi, Borno, Yobe, and

Zamfara states to identify regional variations in competitiveness and comparative advantage.

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