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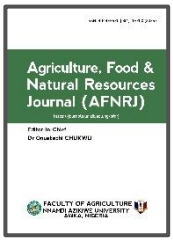

Review Article

SWOT analysis of rice processing industry in Kano State, Nigeria: An empirical review

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A B S T R A C T

The rice processing industry in Kano State, Nigeria, plays a pivotal role in the country's agricultural economy, contributing to food security and employment. This study aims to assess the strengths, weaknesses, opportunities, and threats within Kano's rice processing sector. A systematic review was adopted with the aid of a strength, weaknesses, opportunities, and threats (SWOT) analysis to evaluate the secondary information reviewed about rice value chain activities in Kano State, especially on rice processing industry-related studies. Results of the evaluation reveal the high profitability, availability of raw materials, and established irrigation systems as the strengths of the processing industries in the state. Weaknesses reported were low mechanization, high input costs, and poor infrastructure. Opportunities for growth lie in modernization, mechanization, and government support, while threats such as fluctuating input costs, competition with imported rice, and inconsistent government policies hinder the industry's potential. It is therefore concluded that the rice processing industry in Kano shows great potential for growth and profitability, but significant challenges need to be addressed. Investments in mechanization, infrastructure improvements, and access to credit are essential to overcoming the weaknesses and mitigating the threats facing the industry and are hence recommended.

K E Y W O R D S : *Mechanization, Processing, Profitability rice, SWOT*

INTRODUCTION

The agricultural sector in Nigeria provides employment for nearly 55% of the population and contributes around 40% to the nation's GDP, a significant decrease from the 75-80% share of GDP before oil was discovered (Aremu, 2014). The commercial discovery of oil shifted the country's attention away from agriculture, causing a sharp decline in agricultural productivity. This shift also led to an increased dependence on food imports to satisfy domestic food needs (Osabuohien, 2018). As a result, Nigeria, which was once self-sufficient in food production, turned into a net food importer, spending billions of dollars each year on food imports (Ifeoma, 2019). Between 2012 and 2015, the country imported about $4 billion worth of rice to meet rising consumption needs (Morse, 2019). In order to curb the massive expenditure on rice imports, Nigeria introduced policies focused on increasing local production. These policies included banning rice imports through land borders and

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imposing heavy levies on rice brought in by sea. Despite these actions, rice demand in 2018 reached 7.0 million metric tons (MMT), while local production only accounted for 4.8 MMT, resulting in a substantial gap that had to be met with imports (United States Department of Agriculture (USDA), 2019).

Rice (*Oryza sativun*) is a staple food in Nigeria, much like other carbohydrate-rich foods such as gari, corn, and yam, and it is consumed by people across all social classes. It plays a vital role in the country's food security, supplying at least 2400 calories per person daily (Bamidele *et al.*, 2010). Since the mid-1970s, rice consumption in Nigeria has grown at an impressive annual rate of 10.3%. This surge is mainly driven by the country's rapidly growing population, rising per capita consumption, increased urbanization, higher income levels, and changes in household occupational structures (Ayanwale & Amusan, 2012). Consumer preferences for rice quality are strongly shaped by both genetic factors and post-harvest handling, making the attributes of rice highly significant in their purchasing decisions (Mhlanga, 2010). Consumers frequently have to weigh the pros and cons of various rice varieties, each offering distinct characteristics. As a result, improving the quality and competitiveness of domestically grown rice varieties is crucial to reducing dependence on imports and boosting local rice consumption (Mgendi, 2014).

Kano State, located in Nigeria's north-west region, is a key contributor to the country's rice production, accounting for approximately 72% of the national output. The state produces about 2.8 million metric tons (MMT) of rice annually, with an average yield of 3.72 tons per hectare during the wet season and 4.28 tons per hectare in the dry season (Kano Investment Promotion Agency [KANINVEST], 2018). Kano's significant role in rice production is further reinforced by the availability of over 22,000 hectares of irrigated farmland, managed by the Hadejia-Jama' are River Basin Development Authority (Bello *et al.*, 2015). However, despite the large-scale production, Kano's rice processing industry encounters several challenges. Rice processing involves several steps, including husk removal, milling to eliminate the bran layer, and additional whitening to enhance its appearance. Each stage of this process generates byproducts such as husks and bran, alongside the polished rice kernel (Schramm, 2006).

The rice processing industry in Kano plays a crucial role in Nigeria's agricultural sector by contributing to food security, improving livelihoods, and driving economic growth. Despite Kano State's importance as a leading rice producer in Nigeria, the local rice processing industry encounters significant challenges, particularly in product quality and post-harvest management. Many consumers have historically avoided locally processed rice due to its perceived poor quality, which stems from outdated processing technologies and insufficient infrastructure. This has resulted in dependence on rice imports to satisfy domestic demand. However, due to the rising cost of foreign rice, consumers are now turning towards higher-quality, well-processed local rice. Consequently, it is essential to assess the strengths, weaknesses, opportunities, and threats in Kano's rice processing sector, with a special emphasis on enhancing the quality and competitiveness of locally processed rice to further reduce reliance on imports and improve food security.

Theoretical Framework on Rice Processing Industries

To provide a comprehensive analysis, this study utilizes various theoretical models such as the Resource-Based View (RBV), Industrial Organization (IO) theory, Porter's Five Forces model, Institutional Theory, Sustainable Livelihoods Approach (SLA), and Stakeholder Theory, which together offer a robust framework for evaluating the SWOT of Kano's rice processing sector.

Resource-Based View (RBV) Theory

The Resource-Based View (RBV) provides a foundation for analyzing the internal capabilities and resources that give processors a competitive advantage. The RBV emphasizes that firms can achieve sustainable competitive advantages by utilizing valuable, rare, inimitable, and non-substitutable resources (Barney, 1991). In the context of Kano's rice processing industry, these resources include access to locally grown rice, skilled labor, technology for milling, and established business networks. However, the industry also faces internal weaknesses such as outdated machinery, limited access to financing, and inadequate infrastructure, which constrain efficiency and competitiveness (Olawale, 2019). Examining the industry's internal strengths and weaknesses through the RBV lens will allow to provides insights into how these factors influence the performance and growth potential of rice processors in Kano.

Industrial Organization (IO) Theory

The Industrial Organization (IO) theory, as proposed by Bain (1959), offers a valuable approach to understanding the external environment of the rice processing industry. IO theory focuses on how market structures and competitive dynamics impact firms' profitability and market position. In Kano State, the rice processing sector is influenced by external factors such as market demand, competitive rivalry, entry barriers, and government regulations. Opportunities in this market include growing consumer demand for locally produced rice, government incentives for agricultural processing, and export potential. On the other hand, threats such as competition from imported rice, price volatility, and changes in trade policies represent significant challenges (Sanni *et al*., 2018). The study can assess how external opportunities and threats shape the competitiveness and sustainability of rice processors in Kano by applying IO theory.

Porter's Five Forces Model

Competitive environment can be best explored with Porter's Five Forces model, which expands on IO theory by evaluating five key forces: supplier power, buyer power, threat of substitutes, threat of new entrants, and competitive rivalry (Porter, 1980). In Kano's rice processing industry, supplier

power is largely determined by rice farmers who provide the raw material for processing. The concentration of farmers, seasonal production cycles, and the bargaining power they wield can significantly impact the processors' cost structure (Ahmed & Olalekan, 2020). Buyer power is also critical, as major buyers, including local retailers and consumers, influence pricing and quality demands. Furthermore, the study examines the degree of competitive rivalry among processors in Kano and the threat posed by imported rice and substitute grains like maize and sorghum. These factors provide a clearer picture of the competitive pressures faced by rice processors in Kano and how they can strategically position themselves in the market.

Institutional Theory

The Institutional Theory highlights the role of formal and informal institutions in shaping the practices and development of industries. In the context of Kano's rice processing industry, government policies, trade regulations, and institutional support mechanisms play a pivotal role in determining the industry's growth trajectory. North (1990) emphasized that institutions, including legal frameworks, regulatory bodies, and social norms, influence economic activities by either enabling or constraining market participants. The Nigerian government has introduced several initiatives, such as the Anchor Borrowers' Program and agricultural subsidies, aimed at boosting local rice production and processing (Adebayo & Shehu, 2019). However, bureaucratic inefficiencies, policy inconsistencies, and corruption often hinder the effectiveness of these programs. Institutional Theory assesses how institutional frameworks impact industry's opportunities and threats, with particular attention to the regulatory environment and institutional support for the industries such as rice processors in Kano.

Sustainable Livelihoods Approach (SLA)

The Sustainable Livelihoods Approach (SLA) provides a lens for understanding the socioeconomic impact of rice processing on local communities in Kano. SLA emphasizes the importance of enhancing people's capabilities and assets to achieve sustainable development (Scoones, 1998). In Kano, rice processing contributes significantly to livelihoods by creating employment opportunities, generating income, and improving food security. However, challenges such as unequal access to resources, particularly for smallholder farmers and women, pose significant weaknesses in the industry's ability to contribute to broad-based development (Omotayo *et al*., 2020). SLA provides basis to evaluate how rice processing affects local communities and how the industry can better integrate sustainability practices to ensure that benefits are distributed equitably.

Stakeholder Theory

Stakeholder Theory is essential for analyzing the interests and influences of different groups involved in the rice processing industry in Kano. Freeman (1984) argues that organizations must consider the needs and concerns of all stakeholders, including customers, suppliers, employees, and regulatory agencies, to achieve long-term success. In the context of Kano's rice processing industry, key stakeholders include rice farmers, processors, government bodies, financial institutions, and consumers. The dynamics between these stakeholders play a crucial role in determining the industry's strengths, weaknesses, opportunities, and threats (Ibrahim *et al*., 2017). This study examines how stakeholder relationships influence the industry's development and identifies strategies for fostering collaboration and addressing stakeholder concerns to promote sustainable growth.

Review on Rice Processing in Nigeria

There are a number of researches conducted on rice processing in Kano in particular and Nigeria at large. These aforementioned literatures highlight key issues in rice production and processing across Nigeria, including the need for mechanization, access to finance, and improved infrastructure to enhance productivity. A study by Inuwa *et al.* (2021) assessed the profitability levels of rice processing, revealing that millers generate significant Net Milling Income and value-added services. The study recommends enhancing cooperative societies for bulk purchase and transportation to reduce costs; another study focused on the economic efficiency of rice farming in Kano by Tanko *et al*. (2020). It revealed that properly utilizing inputs like fertilizers and seeds could increase productivity. Improving rural infrastructure and educational systems is suggested to enhance the efficiency of rice farmers. Adu *et al*. (2012) researched on the level of mechanization in Kano State which revealed that most rice processing stages, apart from de-husking, rely on manual labor. This highlights the need for increased mechanization to improve productivity.

In other part of Nigeria for instance Ogun State, study by Osabuohien *et al*. (2018) indicated that the availability of modern rice processing machines in farmers' clusters significantly improved rice processing efficiency. However, agricultural financing remains a major challenge. Okeke & Oluka, (2017) in a survey in South-East, Nigeria showed that manual labor is predominant in rice production, with limited mechanization. Farmers rely heavily on traditional techniques, which affect productivity. A comparative study in Benue State showed that modern rice processing techniques were more efficient and profitable than traditional methods. However, challenges like lack of capital and poor infrastructure limit the adoption of modern methods (Tando, 2017). In Imo State, a study focused on post-harvest management by Adeola (2020) revealed significant losses due to inadequate techniques and lack of awareness. Improved post-harvest practices were recommended to minimize losses. This preliminary review had shown the paramount of rice processing in Nigeria, particularly in Kano State. However, there is paucity of empirical evidences on the strength, weakness, opportunities and threats of rice processing industries, this study therefore will provide a critical overview of SWOT analysis of rice processing industries in Kano State.

Sadiq *et al*. (2022) explored the paddy rice processing value chain through a SWOT analysis, revealing insights into strengths, weaknesses, opportunities, and threats for par-boilers. Most respondents perceived the presence of these factors as significant. The key strengths identified were social connections, the availability of rural and family labor, government support, agriculture's contribution to the local economy, minimal labor requirements, production of quality rice varieties, access to paddy rice, a large consumer base, and improved living standards due to value addition. Weaknesses included economic issues like employment, lack of skilled labor, inadequate government incentives, high interest rates, limited research, and low private sector involvement. Opportunities highlighted new market segments, partnerships, support from local and international organizations, and growing demand both locally and internationally. Major threats were limited research, inconsistent government policies, poor access to water, and a low price for substitute goods.

Similarly, millers perceived a high presence of SWOT factors in their enterprise, with an average index exceeding the threshold of 2.0, further confirming the perceived status. Their major strengths included employment, social strength, a pool of skilled workers, technology application, and stable income generation. The major opportunities were new markets, partnerships, local and international demand, technological advancements, and profitability. However, weaknesses and threats, such as poor infrastructure and inconsistent policies, were seen as significant challenges.

The Project Report (2006) also assessed the rice milling industry's SWOT, identifying strengths such as paddy availability, government support for agro-processing, and employment. Weaknesses included marketing difficulties and competition. Opportunities lay in the wide acceptance of processed rice, while the threats were technology-related and competition-based.

Indumathi *et al*. (2015) conducted a SWOT analysis of paddy processing industries in Southern Tamil Nadu, revealing strengths like a vast domestic market and government support. Weaknesses included high working capital requirements and inadequate links with research institutions. Opportunities involved growing rice demand and premium-quality rice. Threats included competition from local players and neighboring states.

Tri (2016) assessed rice commodities in Buru District, identifying strengths such as the application of agricultural technology, socio-cultural support, and government backing. Weaknesses included insufficient infrastructure and economic support, while opportunities were increased market demand and technology development. Threats were land use transformation, climate disruption, and limited financial access for farmers.

Phukno & Kuhaswonvetch (2018) examined the SWOT of the Khao Hinsorn Agricultural Cooperative rice mill in Thailand, highlighting strengths like royal patronage and experienced staff, but weaknesses in milling quality control and machine repair capabilities. Opportunities included broad support from organizations, but threats involved location challenges and underutilization of capacity.

Samuel & Wilson (2019) analyzed the Kenyan rice milling industry, finding strengths in idle capacity, skilled labor, and government support, but weaknesses in poor infrastructure, high costs, and inefficient technologies. Opportunities involved modernizing the milling sector, while threats included rising electricity costs and climate-related challenges.

A 2019 report on agro-processing clusters in Kano State identified strengths in competitive processing, weaknesses in capital and machinery, opportunities in improving rice quality, and threats from competition, financial limitations, and fluctuating consumer preferences. Sani *et al*. (2019) found that small-scale rice processors in Kano River Irrigation Project excelled in organizing paddy procurement but faced financial limitations. Opportunities arose from government efforts to boost local production, while threats stemmed from competition with large processors.

Sadiq *et al*. (2021) analyzed the rice milling cottage industry in Niger State, highlighting strengths like innovative planning tools and access to credit, but identifying weaknesses such as low profitability and poor market conditions. Opportunities included consumer awareness, youth empowerment, and favorable competition, while threats involved market adulteration, government policies, and high material costs.

METHODOLOGY

Study Area

The study area, Kano State, lies between latitudes 10°33'N and 12°37'N and longitudes 70°41'E and 90°29'E of the Greenwich meridian. The State is a key agricultural hub in Nigeria, producing a wide range of food and cash crops like sorghum, rice, millet, groundnut, wheat, cowpea, and various vegetables through both rain-fed and irrigated farming methods (Mustapha & Nabegu, 2011). Notably, in 2017 Kano is one of the country's leading rice-producing regions, with the highest number of rice farmers 214,332 engaged in rain-fed farming and 143,768 involved in irrigated farming (Kano State Agricultural and Rural Development Authority [KNARDA], 2017). Rice also holds the distinction of being the most consumed crop in the state (Maji *et al.*, 2015).

Located in the Sudan Savannah zone, it covers about 20,760 square kilometers. The climate is characterized by a mean daily maximum temperature of 33.1°C (91.6°F) and a minimum of 15.9°C (60.6°F). Kano is bordered by Katsina State to the north and northwest, Jigawa State to the east and northeast, Bauchi State to the south, and Kaduna State to the southwest. Current estimates place Kano's population at roughly 13,324,422, reflecting a 3.3% annual growth rate since the 2006 census, which recorded a population of 9,383,682 (National Population Commission [NPC], 2023).

Kano's agricultural sector is diverse, with crops like millet, sorghum, cowpea, maize, wheat, cotton, gum arabic, groundnut, rice, and various vegetables being the primary products. By-products from these crops also support livestock farming, with cattle, horses, goats, and sheep being common. The state boasts vibrant markets both rural and urban where agricultural goods, including livestock and animal feed, are frequently traded. While most markets operate weekly or biweekly, urban markets run daily (RIM, 2023)

Data Collection and Analysis

This study used secondary information from related literature on rice processing in Kano state, Nigeria. Systematic reviews of existing and related studies were used which were obtained from Google Scholar, Research Gate, and other credible research databases. SWOT analysis was used to evaluate the literature reviewed in relation to rice value chain activities in Kano State especially on rice processing industries-related studies.

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RESULTS AND DISCUSSION

SWOT Analysis of Rice Processing Industries in Kano State

The SWOT analysis table in Table 1 highlights the key internal and external factors affecting the rice processing industry in Kano State, providing insight into the opportunities for growth and the challenges it faces. These results stem from various studies, particularly on rice processing in Nigeria, with a focus on Kano

Table 1: SWOT Analysis of rice Processing Industry in Kano

Strengths	Weaknesses
1. High profitability	1. Low mechanization in the processing stages (manual labor dominant) except for de-husking.
2. Established irrigation systems like KRIP to improve production.	2. Lack of access to credit and modern equipment limits expansion.
3. Availability of raw materials due to large-scale rice farming.	3. Poor infrastructure (roads, storage facilities, processing plants).
4. Skilled labor and traditional knowledge in rice processing.	4. High input costs, including fertilizers, seeds, and other farm necessities.
5. Economic strength (employment, source of income	5. lack of adequate Technology to meet with international standard
6. Social strength	6. Inadequate/poor Infrastructure
Opportunities	**Threats**
1. Increasing local and international demand for rice	1. High input costs, fluctuating prices of seeds, fertilizers, and fuel.
2. Potential for enhanced mechanization and modernization	2. Competition from imported rice reducing market share
3. Government and NGO support for mechanization and modernization	3. Unreliable water supply and waterlogging in irrigation systems
4. Expansion opportunities through improved infrastructure, including roads and storage	4. Unstable power supply
5. off – shelf technologies	5. Inconsistencies in government policies
6. Development of new technology	6. Pest and diseases
7. Adoption of advance technology	7. Raising fuel prices (cost of inputs)

Source: Adopted from (Inuwa et.al., 2021; Nkwi et al., 2022; Wudil et al., 2021 & Sadiq et al., 2021).

Strengths of Rice Processing Industries in Kano State

Rice processing in Kano benefits from substantial land resources, skilled labor, and established marketing channels. The profitability of rice processing, as demonstrated in Kano State, is one of its strengths, studies on rice processing in Kano highlight its profitability, with millers according to (Inuwa *et al*., 2011) enjoying a net milling income of N3, 378,855.08 annually and a high service efficiency (243.3%). The ability of the rice milling industry to generate significant income, even with challenges such as input costs, indicates a strong profit margin and economic viability.

The Kano River Irrigation Project (KRIP) is another notable strength, enabling farmers to increase their rice yield. Although constraints such as waterlogging exist, the irrigation system remains a valuable resource for expanding rice cultivation in the region. As stated by Wudil *et al*. (2021) the project has enhanced rice production by improving water supply and increasing production capacity. Kano State has vast farmland

dedicated to rice farming, with over 135,000 rice farmers operating in the region. This provides a solid foundation for large-scale production. As cited by Tanko *et al*. (2019), the presence of 17 rice clusters across seven local governments is a key asset for the industry, ensuring consistent raw material supply for processors. Research into the efficiency of rice production in Kano shows that farmers are able to achieve increasing returns to scale, Study by Nkwi *et al*. (2022) indicates that Farm size, agrochemicals, and labor contribute significantly to output, allowing for better resource utilization. This efficiency is a critical strength that enhances productivity.

One of the main strengths identified is the high profitability of rice processing, particularly in the milling segment, where millers report substantial net income, making it a financially viable enterprise as adopted from Inuwa *et al*. (2021). The presence of established irrigation systems, such as the Kano River Irrigation Project (KRIP), significantly enhances rice production by providing a reliable water supply to farmers as highlighted by Wudil *et al*. (2021). Furthermore, the availability of raw materials due to the large-scale rice farming in the region ensures consistent processing activities. The industry also benefits from skilled labor with traditional knowledge of rice processing techniques, which has been instrumental in sustaining production despite the limited mechanization Tanko *et al*. (2019). Moreover, in line with Sadiq *et al*. (2021), the rice industry in Kano contributes significantly to the local economy by providing employment opportunities, particularly in rural areas, and fostering social cohesion through cooperatives and community-based activities.

Weaknesses of Rice Processing Industries in Kano State

One significant weakness is the low level of mechanization in rice processing activities, except for de-husking, which is highly mechanized. Most other stages, such as harvesting, parboiling, and drying, have very low mechanization levels, making the process inefficient and labor-intensive (Adu *et al*., 2012). Furthermore, lack of adequate training, insufficient access to credit, and farm inputs, including fertilizers and seeds, have been identified as critical weaknesses in the rice production and processing sectors (Nkwi *et al*., 2022). Poor infrastructure, such as unmotorable roads and a lack of storage facilities, also contribute to inefficiencies in the processing and distribution of rice.

Adu *et al*. (2012) stated that rice processing in Kano State just like other northern Nigerian states, is largely characterized by low levels of mechanization, with many stages of the post-harvest activities, such as parboiling, drying, threshing, and winnowing, relying on manual labor. Only de-husking has achieved 100% mechanization. This low level of mechanization leads to inefficiency and hampers the scaling of production.

Furthermore, high cost of input is another weakness in rice processing in Kano as indicated by Wudil *et al*. (2021). The notable inputs include fertilizer, seeds, and other farm inputs. This makes production expensive and reduces profitability. Additionally, inadequate access to credit further restricts processors from investing in better technologies, limiting their ability to optimize production. Nkwi *et al*. (2022) also stated that lack of adequate infrastructure such as storage facilities, motorable roads, and access to modern processing facilities presents a major weakness for the rice processing sector in Kano. These deficiencies lead to high transportation costs, inefficiencies in production, and reduced competitiveness of locally processed rice in the market.

Extension service provision is another factor which is considered as a weakness in rice processing sector. Balogun *et al*. (2020) stressed that rice farmers and processors in Kano have limited access to extension services, which affects their productivity and efficiency. Access to extension services is critical for disseminating best practices in production and helping farmers adopt improved technologies. The lack of consistent extension support contributes to inefficiencies in the sector.

In addition to that, Rice processors face challenges in accessing markets due to inadequate information about market prices, competition from imported rice, and limited capacity to negotiate better terms with buyers. The limited access to formal markets further restricts the profitability of rice processors in the region (Abdulrahman *et al*., 2019). These weaknesses create significant barriers to growth for rice processing industries in Kano State, requiring targeted interventions to address inefficiencies and improve competitiveness.

Opportunities of Rice Processing industries in Kano State

Opportunities exist in enhancing the mechanization and modernization of rice processing. Increased government and non-governmental organization (NGO) support could lead to better access to modern processing equipment and improved infrastructure, which would significantly boost productivity and efficiency (Tafida & Fiagbomeh, 2021). Collaborative efforts between the government, private sector, and international agencies could also offer opportunities for growth. For instance, partnering with research institutions to train extension agents has been identified as a key strategy for improving agricultural services in the state. The increasing demand for rice both locally and internationally presents an excellent opportunity for Kano's rice processors to expand their market share. Modernizing the value chain and ensuring the quality of processed rice could further increase competitiveness. One of the opportunities which is also a strength, is rice processing profitability in Kano. Studies have shown that the net milling income for millers is substantial, with millers earning around ₦3, 378,855.08 per year (Inuwa *et al*., 2011). These high profit margins create significant opportunities for investment and expansion in rice processing facilities, making it a lucrative sector for local entrepreneurs and external investors.

There are significant opportunities in the development of rural infrastructure that could enhance rice production and processing in Kano. Upgrading road networks, irrigation systems, and

storage facilities could greatly increase productivity and reduce post-harvest losses, contributing to the overall efficiency of the rice processing value chain (Tanko *et al*., 2019). Introducing modern mechanization and technology presents a significant opportunity. There is currently a low level of mechanization in rice processing, which limits production efficiency (Agossadou *et al*., 2018). Investing in modern rice processing equipment, such as mini-harvesters and threshers, could boost productivity and create business opportunities for youth involved in the rice value chain.

Enhancing economic efficiency in the use of fertilizers, seeds, and farmland presents opportunities for increased output and profitability. Improving access to these inputs could save costs for rice farmers, making the processing sector more competitive (Tanko *et al*., 2020). The use of decision support tools commonly known as Rice Advice tool, designed to improve rice productivity and profitability, presents an opportunity for scaling through partnerships and business models. Zossou *et al*., (2020), stated that its widespread use could significantly enhance the productivity of smallholder farmers in Kano State and create new business models around its implementation.

Threats to Rice processing industries in Kano State

Several threats hinder the rice processing industries in Kano. One significant threat is the fluctuating price of inputs, which increases production costs and reduces profitability for processors. Farmers as stated by Wudil *et al*., (2021) also face constraints such as pest infestations, floods, and inconsistent extension services, which impact rice productivity. Inadequate credit facilities pose another threat, limiting processors' ability to invest in modern equipment and expand operations Balogun *et al*., 2022. The increasing competition from imported rice, coupled with the high cost of production, makes it difficult for locally processed rice to compete on the market, which could potentially reduce the market share of Kano's processors. Wudil *et al*., (2021) further indicated that one of the major threats to rice production and processing in Kano is the high cost of inputs, such as fertilizers, seeds, and pesticides. These input costs increase production expenses and reduce profit margins for processors and farmers. They further stated that rice farming in Kano is threatened by unreliable water supply and waterlogging issues, especially in irrigation areas like the Kano River Irrigation Project (KRIP). These problems adversely affect rice production and hinder consistent output.

Fluctuating market prices and difficulty in accessing formal markets pose a threat to rice processors. Small-scale processors are particularly vulnerable to these fluctuations, which can make local rice less competitive compared to imported rice (Abdulrahman *et al*., 2019). Study by Inuwa *et al*. (2011) revealed limited access to credit was considered as a threat. Limited access to financial resources and credit facilities restricts the ability of rice processors to invest in modern equipment or scale up their operations. This lack of financial support affects productivity and competitiveness. Tanko *et al*. (2019) stated that poor infrastructure, including inadequate roads, storage facilities, and processing equipment, continues to be a significant threat to the rice industry in Kano. These deficiencies increase costs and reduce the efficiency of production and distribution.

CONCLUSION AND RECOMMENDATION

The rice processing industry in Kano shows great potential for growth and profitability, significant challenges need to be addressed. Investments in mechanization, infrastructure improvements, and access to credit are essential to overcoming the weaknesses and mitigating the threats facing the industry. The industry can enhance its competitiveness and contribute even more significantly to the local and national economy by capitalizing on the opportunities available, such as increasing demand and government support for modernization.

i. There is a need to increase mechanization by prioritizing government and private sector investments in modern processing equipment to boost productivity and reduce labor-intensive practices.
ii. The entrepreneurs and public and private sectors need to promote market expansion by enhancing processed rice quality and supporting branding and marketing of local rice varieties to boost consumer confidence and reduce import reliance.
iii. Adequate and sustainable credit and financing options for rice processors should be enhanced with financial institutions collaborating with government and NGOs to offer favorable loan terms.
iv. Strengthen extension services by improving access to agricultural extension, and developing training programs in collaboration with research institutions to promote modern technologies and best practices.

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Authors' Contributions

BSS: Conceptualization of the research, Introduction, Theoretical Framework on rice processing, Conclusion, and manuscript editing. BN: Methodology, Data Collection, Empirical Review on rice processing, Result and Discussions.

MW: Abstract, Literature Review, and contribution to the Methodology. AA: Data Analysis, Result and Discussion sections, and contribution to the Conclusion. IYA: Theoretical Framework, Empirical Review, and contribution to the Methodology. AY: Introduction, Literature Review, and contribution to the Result and Discussion sections. BM: Conclusion, Recommendations, and References sections and overall manuscript editing. All authors have contributed, reviewed and approved the final manuscript.

Ethical statement

Not applicable

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