

Research Report

Strengthening Rice Value Chains in Nigeria

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syngenta foundation
for sustainable
agriculture



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Abbreviations and Units

ABP	Anchor Borrowers Program
AfCFTA	African Continental Free Trade Area
AfDB	African Development Bank
AGRA	Alliance for a Green Revolution in Africa
ARCN	Agricultural Research Council of Nigeria
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ATASP	Agricultural Transformation Agenda
AWD	Alternate Wetting and Drying
BMGF	Bill & Melinda Gates Foundation
COMESA	Common Market for East and Southern Africa
CSA	Climate Smart Agriculture
CSE	Combine Service Enterprise
DP	Development Partners
ECOWAS	Economic Community of West African States
FAO	Food and Agricultural Organization
FGN	Federal Government of Nigeria
FMARD	Federal Ministry of Agriculture and Rural Development
FMST	Federal Ministry of Science and Technology
GAP	Good Agricultural Practices
GCRPS	Ground-cover Rice Production System
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GQL	Grain Quality Loss
Ha	Hectares
IFAD	International Fund for Agricultural Development
KII	Key Informant Interview
M	Million
M&E	Monitoring and Evaluation
MIP	Mechanization Implementation Program
MMT	Million Metric Ton
MT	Metric Ton
NAFDAC	National Agency for Food and Drug Administration and Control
NAERLS	National Agricultural Extension and Research Liaison Services
NARPPMMAN	National Rice Producers, Processors, Millers and Marketers Association of Nigeria
NARIs	National Agricultural Research Institutes
NBS	National Bureau of Statistics
NCAM	National Centre for Agricultural Mechanization
NCRI	National Cereals Research Institute
NDC	Nationally Determined Contributions
NGN	Nigerian Naira
NIPC	Nigeria Investment Promotion Commission
NGO	Non-Governmental Organization
NPCCRS	National Policy on Climate Change and Response Strategy
PAD	Precision Development
PGL	Physical Grain Loss
POP	Package of Practices
PRIDAN	Paddy Rice Dealers Association of Nigeria
PRODA	Projects Development Institute
RBDA	River Basin Development Authorities

RECs	Regional Economic Communities
R&D	Research and Development
RIFAN	Rice Farmers Association of Nigeria
SADC	Southern Africa Development Community
SDGs	Sustainable Development Goals
SEEDAN	Seed Entrepreneurs Dealers Association of Nigeria
SFSA	Syngenta Foundation for Sustainable Agriculture
SON	Standard Organization of Nigeria
SRI	System of Rice Intensification
SSA	Sub-Saharan Africa
UEMOA	West African Economic and Monetary Union
UN	United Nations
USAID	United States Agency for International Development
USD	US Dollar
USDA	United States Department of Agriculture
VCDP	Value Chain Development Project
WARDA	West African Rice Development Association
WUE	Water-use Efficiency

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About the Author

Derftdan, the project lead, and field research team, is an agricultural consultancy company in Nigeria with experience covering multiple value chains such as cassava, ginger, rice, tomatoes, and cashew. Derftdan conducts market surveys and researches, provides capacity building, farm establishment, and maintenance, produce aggregation and linkages, and has also built experience in developing business plans, feasibility studies, business proposals, and the economics of production.



A conversion of 1 USD = 415.12 NGN was used throughout this report. Source, [xe.com](https://www.xe.com) as of June 7, 2022.

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Executive Summary

The rice value chain in Nigeria is disaggregated and fragmented. To strengthen it, the links between each chain must be stronger with minimal losses – that is, rice farmers extract the most value from each unit of farming input; processors must unlock more efficiency in capacity; distributing channels must engender smooth trade flows from farm to table and consumers must have access to affordable quality rice all year round.

Nigeria has been a net importer of rice mainly due to insufficient production, quality and quantity losses across the value chain and lack of large-scale value addition. Yet, **Nigeria is the leading rice producer in Africa, with a 70% growth in production in the last decade.**¹ The growth was largely due to increased demand for rice and government support for production. Milled rice production was an estimated 5 Million Metric Tons (MMT) in 2021 with a 9% projected production to increase by end of 2022.² In the past decade, rice consumption increased by 4.7% in Nigeria, almost four times the global consumption growth.³ Due to the war in Ukraine, rice demand and consumption is expected to rise even more worldwide.⁴

Given the importance of rice as a staple food in Nigeria, boosting its production has been accorded high priority by the government. Progress made through efforts led by the Rice Farmers Association of Nigeria (RIFAN) and the Central Bank of Nigeria (CBN) have improved management practices, increased usage of hybrid rice varieties, and expanded rice production area. The development sector has also played a key role in strengthening farmer organizations and boosting production volumes among rice farmers. However, while rice cultivation has increased, yields have remained relatively constant at 2.5 MT per hectare, which is about half of the average achieved in Asia. Thus, there remains potential to raise the productivity and quality of the Nigerian rice industry to a global standard.⁵

Raising Nigeria’s rice industry standard is about addressing inefficiencies in the entire supply chain. Aside from pre-harvest losses due to various factors (e.g., rodents, pests, theft, weather) rice post-harvest losses vary widely from farm to farm, with losses ranging from 8% up to 55%.^{6,7} These losses result in significant industry wastage of produced rice never reaching consumers because of poor post-harvest management practices. Major post-harvest loss of grain occurs across the value chain and farmers, especially in storage, processing, and transportation. These weak links in the supply chain must be addressed to sustain investment efforts in the Nigerian rice value chain.

Nigeria’s rice processing techniques are especially inefficient resulting in processed rice that is expensive and of a lower quality than rice from other countries like China, Vietnam, and India.⁸ Due to the poor quality of locally produced rice, most consumers prefer imported rice from other countries. Nigerian rice processors

¹ Uche M. N. (2019). Nigeria’s Import of Wheat and Rice to rise. GAIN Report.

https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Grain%20and%20Feed%20Annual_Lagos_Nigeria_5-6-2019.pdf

² Boluwade, E. (2022). *Grain and feed annual*. Usda.gov.

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_NI2022-0005.pdf

³ Boluwade, E. (2022). *Grain and feed annual*. Usda.gov.

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_03-15-2021.pdf

⁴ Oluigbo, U. A. (2022). *THE WAR IN UKRAINE HAS HIT AFRICA’S FOOD SECURITY*. Newint.org. <https://newint.org/features/2022/06/07/ukraine-war-has-hit-africa-food-security>

⁵ Boluwade, E. (2022). *Grain and feed annual*. Usda.gov.

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_NI2022-0005.pdf

⁶ Kok, M. G. and Snel, H. (2019). Food loss measurements in the rice supply chain of Olam Nigeria; Analysis of the pilot study results. Wageningen University & Research. Report WCDI-19-084 / WFBR-2000. Wageningen.

⁷ Derftdan farmer survey (2022)

⁸ Obisesan, O. O. (2020). The quality of Nigerian home-grown rice is poor: here’s why. *The Conversation*. <http://theconversation.com/the-quality-of-nigerian-home-grown-rice-is-poor-heres-why-144104>

also lack adequate processing capacity and the financial backing necessary to compete favorably in the market with rice producers from other countries.⁹

The Nigeria rice industry is largely dominated by cottage processors who are more profitable and sustainable as market channels for small-holder farmers. The cottage processing industry is a sustainable source of off-take for farmers' paddy and thus should be given attention in any discussion to strengthen the Nigeria rice value chain.

Nigerian rice farmers, especially those farming 2 ha or less face a variety of challenges, including low-profit margins, low prices, limited access to-mechanization, and marketing bottlenecks. Pricing was the foremost concern of rice farmers as 62% of them do not get favorable price offers for their paddy. Many also struggle to access machinery; 79% of rice farmers find access to mechanization either very difficult or almost impossible.¹⁰

Nigeria can reduce rice importation by 9% by fixing the inefficiencies in milling rice and save an estimated USD 180 million in foreign exchange, which can be reinvested into the rice processing sector to increase the rate of mechanization of existing processors.¹¹ Important insights into improving inefficiencies, especially those in the post-harvest and processing segments, can be drawn from China.

China, the world's largest rice-producing and consuming nation has many lessons to offer Nigeria from its success.^{12,13} China's rice industry has excelled in its technological advances, policy support, mechanization and organization of farmers and supply chain actors.¹⁴ Nigeria can most importantly learn from China about increasing the availability of improved rice seeds, streamlining standards and processes, providing subsidy support for mechanization, and providing numerous opportunities for investment across the rice value chain to boost production and quality.

Key opportunities can be observed throughout the value chain but lie especially in improving post-harvest and processing components of the value chain. Specific areas of focus include preventing post-harvest loss through improving storage facilities, investing in post-harvest technologies, increasing mechanization, and facilitating best practices in processing and transportation. Other opportunities can be seen in the poorly supported and regulated seed system, the under-irrigated Nigerian rice paddy land, and volatile rice commerce environment.

⁹ Idris, A., Rasaki, K., Hodefe, O. J. and, Hakeem, B. (2013). Consumption pattern of Ofada rice among civil servants in Abeokuta Metropolis of Ogun State, Nigeria. *Journal of Biology, Agriculture and Healthcare*, 3(6): 106-112.

¹⁰ Derftdan farmer survey (2022)

¹¹ IRRRI (2022)

¹² Ato, G. (2020). *New to China market product report -rice*. Usda.gov.

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=New%20to%20China%20Market%20Product%20Report%20-%20Rice_Guangzhou%20ATO_China%20-%20Peoples%20Republic%20of_06-05-2020

¹³ World Bank. (2022). *Overview*. World Bank. <https://www.worldbank.org/en/country/china/overview#1>

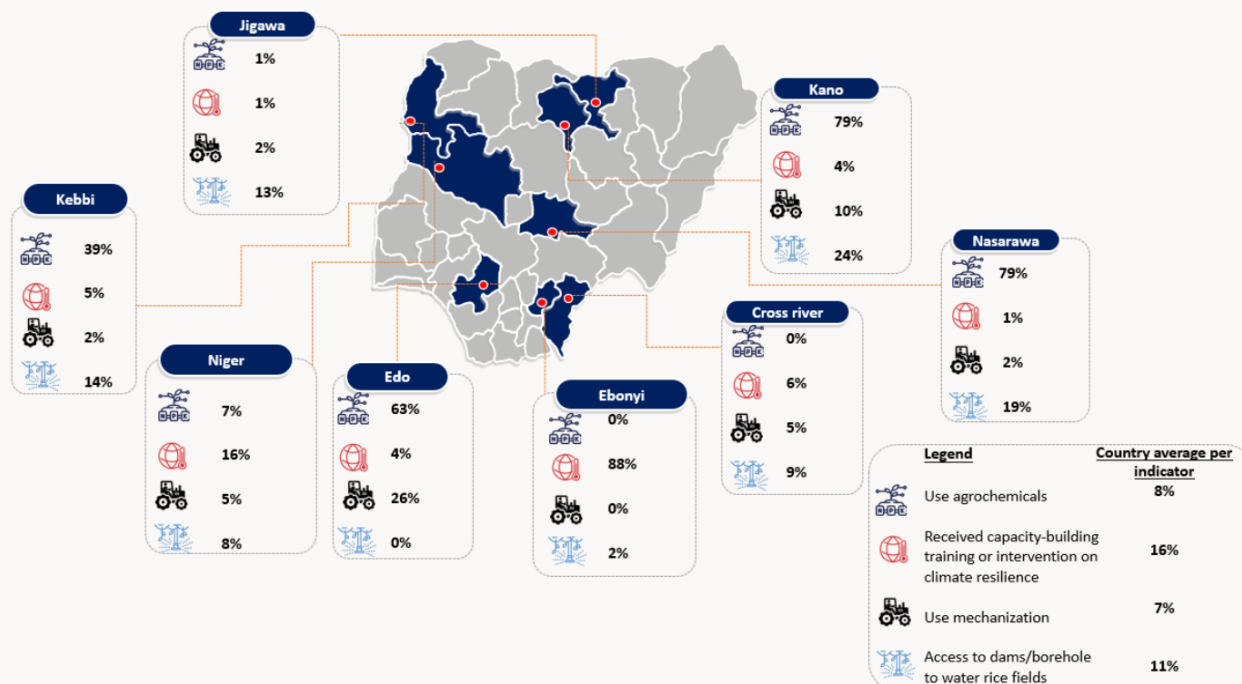
¹⁴ Udoh, U.A. (2014). *Improving Agriculture in Nigeria: Lessons from China*. Accessed from www.nou.edu.ng/NOUN-OCL/pdf/pdf2/AGR20/MAIN.pdf.

Key Statistics of Rice Farmers in Nigeria




Based on a survey of 2,249 rice farmers


86%  14% 




DESCRIPTIVE STATISTICS OF RICE FARMERS

 **86%** have a personal cell phone; 24% have smartphones


 **4** average number of people in household that cultivate rice (Range is 1 - 12 people)


 **2.5 MT/ha** average yield (Range is 0.01 - 15 MT/ha)

 Average price of 50kg bag of rice: **\$1.6 to \$25** depending on the period it was sold.

 **43** average age (Range is 18 - 80 years)


 **63%** average household income from rice production

 **6.1 MT** average annual quantity of rice produced per farmer (Range is 0.006 MT to 240 MT)

 **June** is when rice farmers get the most value for their paddy

- They sell a 50kg bag for up to \$48 (NGN 20,129). While they sell for the least amount of money in August – about \$14 (NGN 5,700).
- Average annual sales is \$2,658 (NGN 1.1 million)

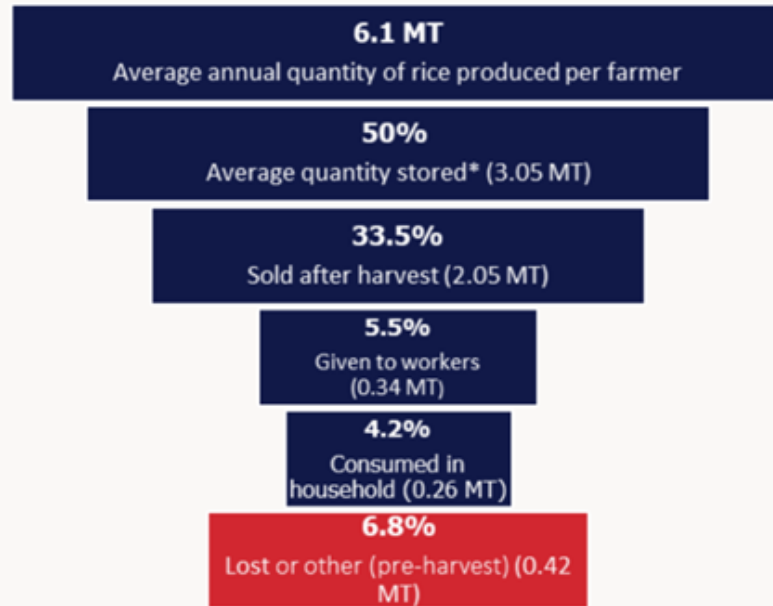
 **9** average number of people in household (Range is 2 - 18 people)

 **2.4 ha** average size of rice farm (Range is 0.25 - 80 ha)

*Storage is for seed and off-season sales

 **98%** grow rice for both cash and consumption

n = 2249



Farmer Segmentation Analysis

	Subsistence 2 ha or less	Medium Between 3 to 5 ha	Commercial 5 ha or more
Average income (million NGN)	0.6	1.5	2.6
Average amount spent on rice seed (NGN)	18,712	86,188	159,738
% with access to a tractor	5 %	8%	8%
Average amount of rice stored (MT)	1.2	1.7	15.4
Most commonly used packaging material for storage	Hermetic bag embedded with polythene	Hermetic bag embedded with polythene	Hermetic bag embedded with polythene

Rice Value Chain Segments in Nigeria

Current Situation Analysis Summary

Pre-Production

Agro-Dealers and Input Suppliers

- The majority of agro-dealers are uncertified, as there is no certification system for agro-dealers in Nigeria
- There are different products on the market with varying degrees of quality
- Agro-dealers and input suppliers double as extension agents in rice producing communities.

Seed Companies

- The Nigerian seed system has been weak and underdeveloped in supplying improved varieties.
- The market value for improved seed is poor
- Key opportunities for improvement in the seed system are in addressing access to improved varieties, good quality and certified seed

Research Institutes /Tertiary Institutions

- Most are academic and not focused on problem-solving research
- Notable names include The Africa Rice Center, IITA, and NCRI
- Foreign and donor interventions are often more problem-solving-oriented than the existing efforts of the government

Production

Individual Farmers

- Average rice farm size is 2.4 ha
- The average annual quantity of rice harvested per farmer is 6.1 MT. Only 4% is set aside for personal consumption.
- On average, about 50% of rice produced per farmer is stored for the off-season

Farmers Associations

- Rice Farmers Association of Nigerian (RIFAN) and the central bank of Nigeria (CBN) work together. For every 10 farmers, 8 of them access financing through RIFAN
- However, local associations often receive too much attention compared to other aspects of the value chain. The government must create a level playing field between production and processing

Government Ministries & Agencies

- The ban on the importation of rice increased local production and consumption of locally milled rice by over 100%
- Since 2004, the government has provided subsidies for the purchase of agricultural machinery for farmers at the provincial level
- Lack of government support, especially in improving the seed system and accessing finance, is a big contributor to the fluctuating growth of the rice market

Financial Institutions (FIs) and Partners

- FIs consider smallholder agriculture too risky. Key reasons include challenges in determining credible borrowers, incurring significant costs in processing many small loans to smallholder farmers
- FIs will almost never give loans to smallholder farmers without third-party intervention
- The Nigerian Federal Government supported Anchor Borrower's Scheme (ABS) loans are characterized by high default rates

Processing

Cottage Processors (Local Millers)

- Cottage processors outnumber industrial processors
- They process about 20% of rice produced by smallholder farmers
- They have 3X more milling power and output than medium to large rice mills
- Major challenges they face are: unstable electricity, increased cost of fuel, unavailability of local markets for spare parts of imported milling equipment, and lack of access to formal credit from banks

Processors (Medium - Large Mills)

- There are about 35 large processors in Nigeria
- They process about 21% of rice produced by smallholder farmers
- While milling at the village level is inefficient and wasteful, access to medium to large scale processors is limited and often very expensive for smallholder farmers

Fabricators

- They are local manufacturers of equipment parts
- Major challenges faced include high costs of production, poor access to finance and, high interest rates
- There has been increased awareness about the adoption of locally fabricated agro-equipment. For example, UtterlyYum, a fruit processing company in Nigeria utilized local fabricators for its equipment. In addition, Agricultural Machineries and Equipment Fabricators Association of Nigeria (AMEFAN) nominated 23 apprentices to the annual NCAM youth empowerment and skill acquisition training in 2018.

Implementing Partners

- Implementing partners could be development organizations, NGOs, and private agribusinesses that have a wealth of experience in supporting the rice value chain in Africa.
- Examples include Technoserve, Precision Agriculture for Development, Extension Africa.

Commerce

Service Providers/Aggregators

- Aggregators are the biggest off takers, collecting rice from 64% of rice farmers surveyed
- The absence of specialized service providers in the value chain impacts production
- Some waste and the remaining is stored for the off-season

Traders (Paddy and Finished Product)

- These are characterized by market actors who sell rice in informal open-air markets and neighborhood shops
- They are ubiquitous in every market in the country
- They are mainly independent, although some are connected to a larger company
- They are one of the biggest off takers of rice from rice farmers
- Lack of capital is a major concern for them, especially as consumers begin to request more credit and default

1. Introduction



Key Takeaways

1. Insufficient local rice production has emerged as a significant food security issue in Nigeria.
2. Nigeria is laying the foundation to boost local production of rice and stimulate private sector involvement.
3. A key opportunity to boost the rice sector in Nigeria is to focus on post-harvest and processing.

Rice is a staple food for over 50% of people worldwide.¹⁵ It is one of the most consumed staples in Nigeria with per capita consumption between 34 kg/year to 50 kg/year and provides the single largest source of income to farmers.^{16,17,18} Increasing demand stems from increasing consumer preferences for rice meal recipes alongside a growing population.¹⁹ However, although Nigeria ranks first in rice production in Africa, local production does not meet consumption demands. About 5 Million Metric Tons (MMT) of milled rice were produced in 2021, whereas consumption was 7.20 MMT.²⁰ In addition, the contribution of rice to Gross Domestic Production (GDP), currently 0.25%, is much lower than its potential if losses are minimized across the value chain. In recent years, insufficient local rice production has emerged as a significant food security issue in Nigeria.²¹

The Nigerian agricultural landscape is changing, with increased government policies aimed at stimulating private sector involvement and boosting local production of rice. Current policies and programs under the government's Agricultural Transformation Agenda, such as the Agriculture Promotion Policy, have yielded promising results in terms of improved production practices, increased usage of hybrid seeds, and expanded production areas.²² The recently approved National Agricultural Technology Innovation Program (NATIP) will also attempt to improve the value chain, specifically focusing on improving processing and climate and land management.²³ However, as NATIP is yet to be implemented, there has been little improvement in the post-harvest and processing components of the value chain.

Within the rice sector in Nigeria, the rice post-harvest and processing segments are especially lagging in terms of capacity, productivity, technology adaptation, and prevention of post-harvest loss. This stands in contrast to the post-harvest and processing segments in leading rice producers like China, which have, through various means, significantly reduced post-harvest loss. If best-in-class practices were achieved, there is an opportunity for Nigeria to significantly scale its rice production and cost competitiveness for both domestic consumption and export. For a rice post-harvest system to be efficient and sustainable, the focus should be on minimizing losses and maximizing the quality of the harvested rice until it reaches the final consumer.²⁴ A

¹⁵ KPMG 2019. Rice Industry Review. <https://assets.kpmg/content/dam/kpmg/ng/pdf/audit/rice-industry-review.pdf>

¹⁶ Mghenyi, E., Cora, D., James, T. and Chidozie, A. (2019). "Transforming Agribusiness for Inclusive Recovery, Jobs Creation and Poverty Reduction: Policy Reforms and Investment Priorities". Main Report. World Bank, Washington, DC. © World Bank."

¹⁷ KPMG 2019. Rice Industry Review. <https://assets.kpmg/content/dam/kpmg/ng/pdf/audit/rice-industry-review.pdf>

¹⁸ Boluwade, E. (2022). *Grain and feed annual*. Usda.gov.

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_NI2022-0005.pdf

¹⁹ Boluwade, E. (2022). *Grain and feed annual*. Usda.gov.

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_NI2022-0005.pdf

²⁰ Boluwade, E. (2022). *Grain and feed annual*. Usda.gov.

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_NI2022-0005.pdf

²¹ Castro, M. (2020). What's the impact of modern rice farming in Nigeria? *British International Investment*. <https://www.bii.co.uk/en/news-insight/insight/articles/whats-the-impact-of-modern-rice-farming-in-nigeria/>

²² *African development fund agricultural transformation agenda support program -phase 1 (atasp-1) country: Federal republic of Nigeria*. (2013). Afd.org. https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Nigeria_-_Agricultural_Transformation_Agenda_Support_Program_-_Phase_I_-_ATASP-I_-_Appraisal_Report.pdf

²³ Isaac, N. (2021). *NATIP policy implementation will fast-track agricultural revolution – Shehuri*. Science Nigeria. <https://sciencenigeria.com/natip-policy-implementation-will-fast-track-agricultural-revolution-shehuri/>

²⁴ Okpiaifo, G., Durand-Morat, A., West, G. H., Nalley, L. L., Nayga, R. M. and Wailes, E. J. (2020). Consumers' preferences for sustainable rice practices in Nigeria. <https://doi.org/10.1016/j.jgs.2019.100345>

pre-requisite to this, however, is improving seed varieties, access to inputs, and mechanization. For these practices, insights can also be drawn from China.

1.1 Purpose of the Report

The goal of this report is to provide an overview of the rice production and post-harvest and processing segment of the value chain in Nigeria, identify challenges in the production and post-harvest and processing segments, and explore strategies for translating China's successful value chain practices into approaches that can be adapted by Nigeria to boost its rice production and processing.

The study will feed into a streamline of activities spearheaded by Derftdan Resources Limited to develop a rice value chain strategy for Nigeria and work in close consultation with public and private sector stakeholders such as SFSA, BMGF, and AGRA. The goal is to identify the funding gaps and establish priorities, targets, and timelines for mobilizing resources from domestic and international investors and donors in support of a strengthened rice value chain in Nigeria.

The study is supported by 2,249 farmer surveys conducted across eight states in Nigeria (Cross River, Edo, Ebonyi, Jigawa, Kano, Kebbi, Nasarawa, and Niger), a deep-dive literature review, 211 Key Informant Interviews (KIIs) with stakeholders including government agencies, processors, financial institutions, fabricators, and service providers. The desk research and analysis of primary and secondary data was completed by Derftdan Resources Limited.

2. Global Rice Industry



Key Takeaways

1. Rice is the 2nd most important staple crop worldwide, behind maize.
2. Asia accounts for 90% of global output; China is a leading producer with 30% of global rice production.
3. Irrigated rice systems make up 54% of global rice harvested area yet leads to 75% of global rice production.
4. Nigeria has a low yield of 2.5 MT/ha, compared to other leading rice production countries (4.1-7.1 MT/ha).

Rice is the staple food of more than half of the world's population; it is the second largest staple crop globally, behind maize.²⁵ Global production and consumption have grown over the years with most of the growth attributed to the increasing population and economic growth in Asia and Africa.

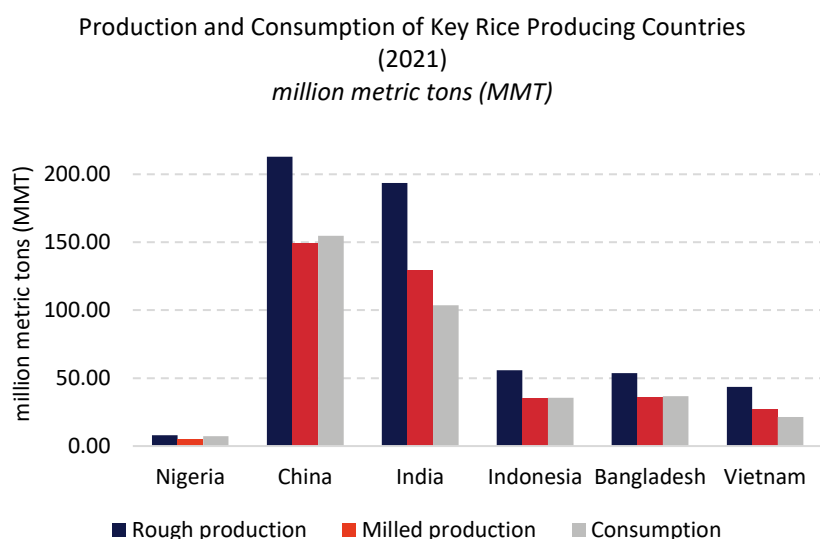


Figure 1: Production and Consumption of Key Rice Producing Countries

Source: USDA 2022

More than 500 MMT of milled rice is produced every year with Asia accounting for about 90% of the global output.²⁶ High production in Asia is due to the increasing land area available for cultivation, the adoption of innovative farming practices that improve yield, and diverse farmer-led rice supply chains; high consumption is due to the continent's large populations, especially in China and India.²⁷

China is the world's largest rice-producing and consuming nation responsible for approximately 30% of the world's total production.^{28,29} As Nigeria's

population grows, total rice consumption is expected to rise to approximately 11 MT by 2030.³⁰ Both Asia and Africa import rice every year to meet demand, however, the volume of annual rice imports among the leading rice importers fluctuates due to frequently unstable rice prices and yields. Global trade of milled rice is projected to be 49.5 MMT in 2022 with the largest imports coming from China (10%), the Philippines (5.7%), and Nigeria (5%). See Figure 1 for an overview of rough paddy production, milled production and consumption volumes of key rice producing countries, Figure 2 for the trend of milled production in key producing countries, and Figure 3 for the import trend.

Two key factors affecting the success of a country's rice value chain are irrigation and mechanization. **Irrigated rice systems represent 54% of the world's harvested area and provide 75% of the world's rice production.**³¹

²⁵Wikipedia 2021. <https://en.wikipedia.org/wiki/Rice>

²⁶ KPMG (2019). Rice Industry Review. <https://assets.kpmg/content/dam/kpmg/ng/pdf/audit/rice-industry-review.pdf>

²⁷ KPMG (2019). Rice Industry Review. <https://assets.kpmg/content/dam/kpmg/ng/pdf/audit/rice-industry-review.pdf>

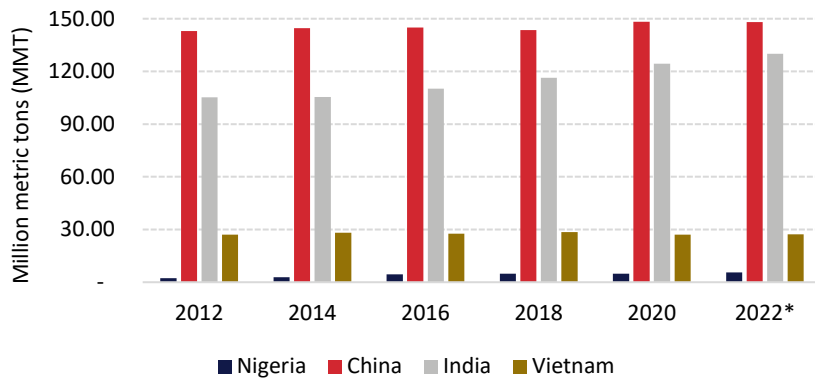
²⁸ GIZ (2020). Southeast Asia: Satellite data for rice cultivation. <https://www.giz.de/en/workingwithgiz/43933.html>

²⁹ Mordor Intelligence (2021). CHINA RICE MARKET - GROWTH, TRENDS, COVID-19 IMPACT, AND FORECAST (2022 - 2027). <https://www.mordorintelligence.com/industry-reports/china-rice-market>

³⁰ OECD-FAO Agricultural Outlook 2021-2030

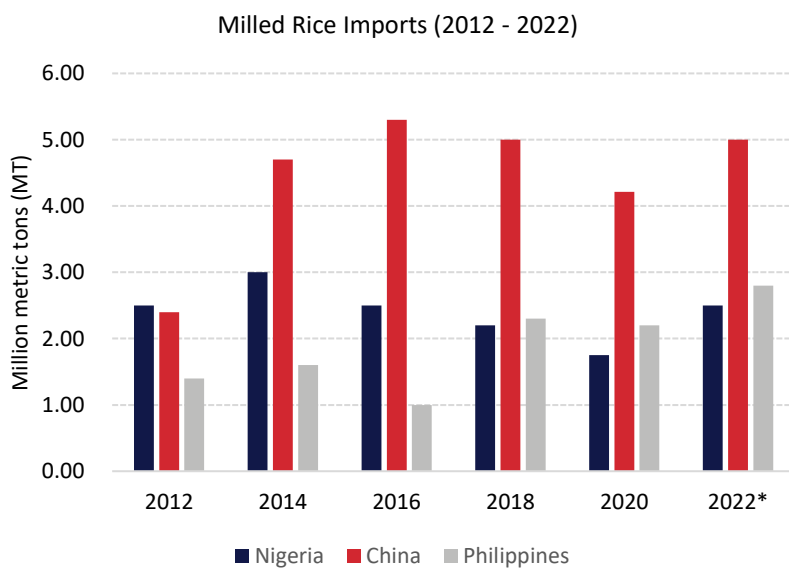
³¹ KPMG (2019). Rice Industry Review. <https://assets.kpmg/content/dam/kpmg/ng/pdf/audit/rice-industry-review.pdf>

Rainfed environments (lowland and upland) account for 39% of global harvested rice area and 24% of the world’s rice production. Figure 4 illustrates the types of rice systems as a percentage of total arable land used for rice.



- The production volumes of milled rice in India and Nigeria increased steadily from 2012 to 2021 and are projected to increase further in 2022.
- China and Vietnam experienced fluctuations in milled rice production. The largest production volume since 2012 was in 2018 in Vietnam and 2020 in China.

Figure 2. Trend of Estimated Milled Rice Production for Nigeria, China, India & Vietnam
Source: USDA (2012 - 2022). *Forecast



- The global rice market is unstable with fluctuations in imports volume across countries due to various price alterations.
- Nigerians’ preference for imported rice is a contributing factor to the increase in importation. Nigeria banned rice importation since 2015 explaining the decline between 2014 and 2020. However, the upcoming elections in 2023 are expected to increase importation.
- China remains the largest importer of rice.

Figure 3: Trend of Estimated Milled Rice Imports for Nigeria, China & Philippines
Source: USDA (2012 - 2022). *Forecast

Environments Where Rice is Grown Globally
% of total arable land

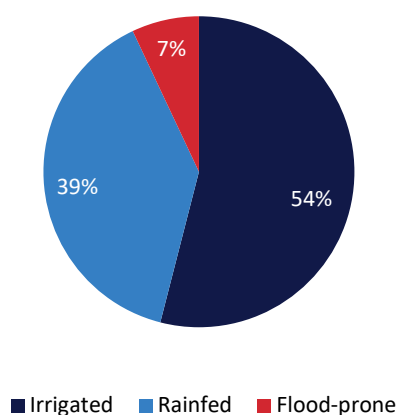


Figure 4: Environments Where Rice is Grown as a Percentage of Global Arable Land

Source: KPMG, 2019

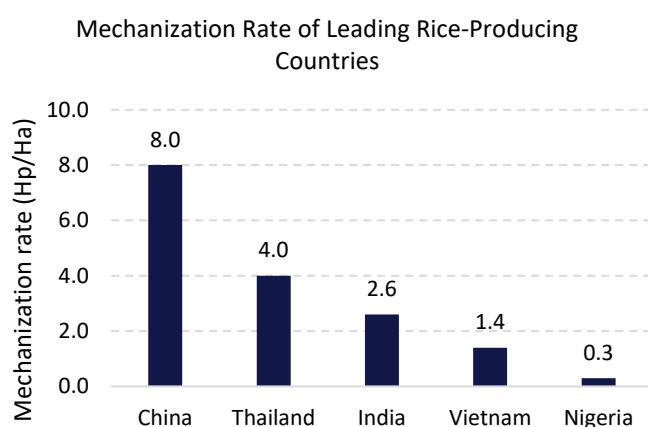


Figure 5: Mechanization Rate of Leading Rice-Producing Countries.

Sources: Derftdan 2022; Global Newswire 2020

Agricultural mechanization is an important indicator of a country's rice industry productivity. Nigeria has one of the lowest mechanization rates in the world at 0.3 horsepower per hectare (hp/ha) while China's mechanization rate is 8 hp/ha (Figure 5). One aspect shared by Nigeria and other Asian countries is the inefficient and unproductive utilization of machinery. This is partly due to low technical knowledge of operating machines and the fragmentation of rice fields as small-scale farmers dominate both markets.³²

In conclusion, rice is a key staple food fundamental to ensuring food security for the global population. Irrigation and mechanization, along with other practices such as strengthening seed systems and addressing technical skills gaps, are key to increasing the productivity of supply chains. The following section further compares Nigeria to other key rice-producing countries on various economic and competitive factors.

³² Yunchao, T., Liang, G., Lufeng, L., Junfeng, G., Ya, X., Chao, C., Hao, G. and Huaibo, S. (2022). Agriculture 2022, 12(2), 287; <https://doi.org/10.3390/agriculture12020287>

3. Nigerian Rice Industry



Key Takeaways

1. Nigeria is the largest producer of rice in Africa with rough rice production of 7.94 MMT in 2021.
2. The ban on the importation of rice has increased local production and consumption of locally milled rice by over 100%.
3. Nigeria is gradually closing the deficit in rice production; harvest area and best production practices are on the rise, including an increase in irrigated production.
4. Only 63% of rice produced is milled; while production practices are improving, the post-harvest supply chain is heavily fragmented with low technology integration.

3.1 Rice Production in Nigeria

Nigeria is the largest producer of rice in Africa with 70% production growth in the last decade.³³ Rough rice production was 7.94 MMT in 2021 and is projected to reach 8.7 MMT in 2022 (Figure 6).³⁴ Milled rice production was an estimated 5 MMT in 2021 and is forecasted to be 5.5 MMT in 2022. Nigeria has a total estimated landmass of 91 million hectares (ha) with 34 million ha of arable land.³⁵ The rice area harvested in Nigeria grew from about 3.1 million ha in 2016 to 3.6 million ha in 2021 and is projected to increase by 4% to 3.8 million ha in 2022 (Figure 7).³⁶ The total rice area harvested is mainly spread across 18 of the 36 Nigerian states, with the Northwest accounting for 72% of total rice production.³⁷ Population growth, rural-to-urban migration, and increasing consumer preferences for rice meals have increased the importance of rice as an important tool for ensuring food security in Nigeria.³⁸ In terms of consumer preferences, studies have found that consumers tend to prefer parboiled and moderate to flaky rice as opposed to non-parboiled and soft, sticky rice.³⁹

Rough and Milled Rice Production in Key African Countries (2022*)

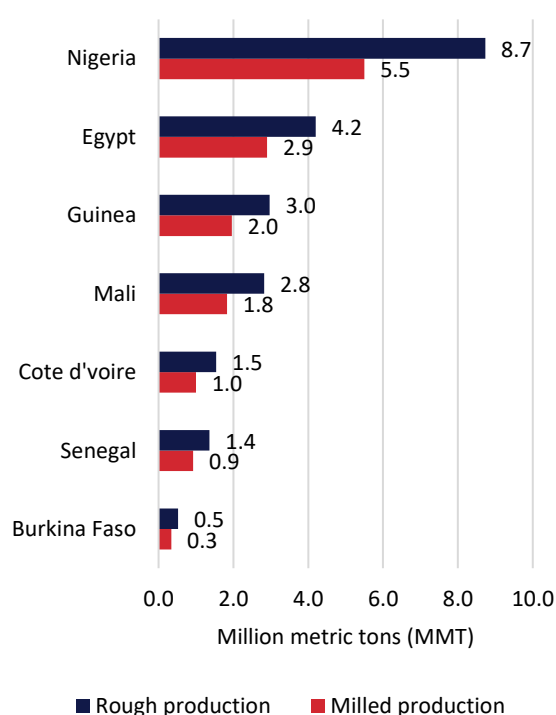


Figure 6: Rough and Milled Rice Production in Nigeria and Other African Countries
Source: USDA 2022, *Forecast/estimated

³³ Uche M. N. (2019). Nigeria's Import of Wheat and Rice to rise. GAIN Report.

https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Grain%20and%20Feed%20Annual_Lagos_Nigeria_5-6-2019.pdf

³⁴ Nigeria is Now the Biggest Producer of Rice in Africa. (2019). AllAfrica.com. <https://allafrica.com/view/group/main/main/id/00066911.html>

³⁵ World Bank (2020). <https://data.worldbank.org/indicator/AG.LND.TOTL.K2?locations=NG>

³⁶ BBC News (2022). Nigeria Rice: Is the government exaggerating production figures?. <https://www.bbc.com/news/60324939>

³⁷ GEMS4 (2017). Mapping of Rice Production Clusters in Nigeria. A Project Report on Growth and Employment in States by the United Kingdom Department of International Development (DFID) in Nigeria, 66

³⁸ Uche M. N. (2019). Nigeria's Import of Wheat and Rice to rise. GAIN Report.

https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Grain%20and%20Feed%20Annual_Lagos_Nigeria_5-6-2019.pdf

³⁹ Adeyeye, J. A., Navesero, E. P., Ariyo, O. J., Adeyeye, S. A. (2010). Consumer preference for rice consumption in Nigeria. *Journal of Humanities, Social Science and Creative Arts*, 5(1), 26–36. <https://catalog.ihsn.org/citations/61382>

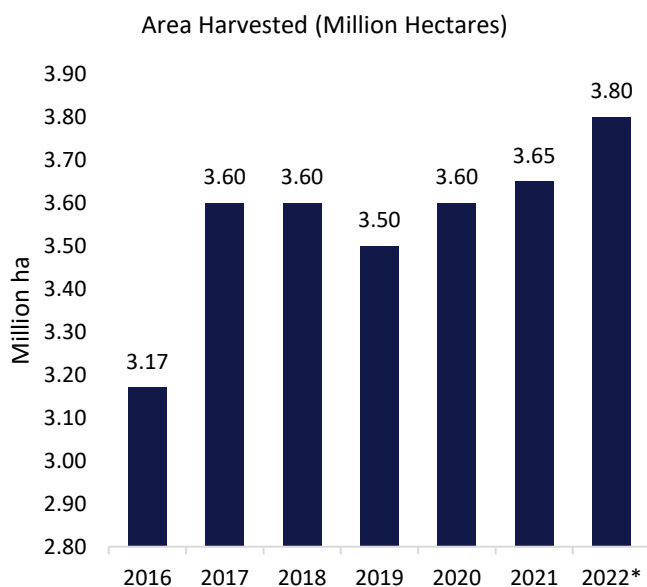


Figure 7: Rice Area Harvested in Nigeria (Million Hectares)
Source: USDA 2022, *Forecast/estimated

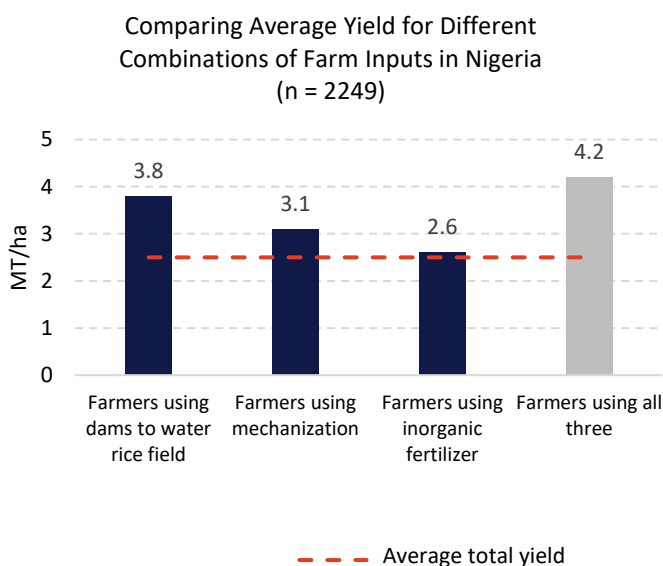


Figure 8: Comparing Average Yield for Different Combinations of Farm Inputs in Nigeria
Source: Derftdan Farmer Survey 2022

Although cultivation is increasing, rice yields in Nigeria remain around 2.5 MT/ha, less than half the average yield in Asia (Range in Asia is 4.1 - 7.1 MT/ha).⁴⁰ 61% of rice farmers in Nigeria have a yield of 2 MT/ha or less.⁴¹ One reason for this low yield is poor soil health; only 0.7% of rice farmers in Nigeria have conducted a soil analysis in the past three years, meaning they do not know their soil profile.⁴² Low access to agrochemicals also contributes to the low yield. However, there is significant potential to raise productivity. By adopting mechanization, using inorganic fertilizers, and having access to a dam as a main source of water for rice fields, rice farmers can improve average yield by 68% (from 2.5 MT/ha to 4.2 MT/ha). See Figure 8.

Nigeria's rice production is largely non-irrigated and grown by smallholder farmers, but that is changing.⁴³ Although irrigation allows for better control of production variables, rainfall remains the main source of water for 51% of rice farmers in Nigeria; 23% use rivers or streams to water crops (Figure 9).⁴⁴ With increasing access to irrigation techniques during the dry season, some rice farmers (about 5%) are now experimenting with planting rice twice in a season and moving away from a singular rice season, specifically in the South-east (Cross river and Ebonyi) and Nasarawa.^{45,46} This, alongside increasing interest by stakeholders (both government and private players) in supporting rice farmers with funds and inputs via out-grower schemes, is healthy for the sector. Rice production in Nigeria is projected to grow over the next decade, although high fuel prices may pose a

⁴⁰ Derftdan Farmer Survey (2022)

⁴¹Uche M. N. (2019). Nigeria's Import of Wheat and Rice to rise. GAIN Report

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_NI2022-0005.pdf

⁴² Derftdan Farmer Survey (2022)

⁴³ Takeshima, H., Bakare, O. S. (2016). Production systems: Biophysical and economic environment and constraints. In The Nigerian rice economy: Policy options for transforming production, marketing, and trade. Gyimah-Brempong, Kwabena; Johnson, Michael E.; and Takeshima, Hiroyuki (Eds.) Chapter 3. Pp. 51-84. Washington, D.C.: International Food Policy Research Institute (IFPRI). <http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/130484>

⁴⁴ Derftdan Farmer Survey (2022)

⁴⁵USDA and GAIN (2022). Grain and Feed Annual.

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_NI2022-0005.pdf

⁴⁶ Derftdan Farmer Survey (2022)

challenge.^{47,48}

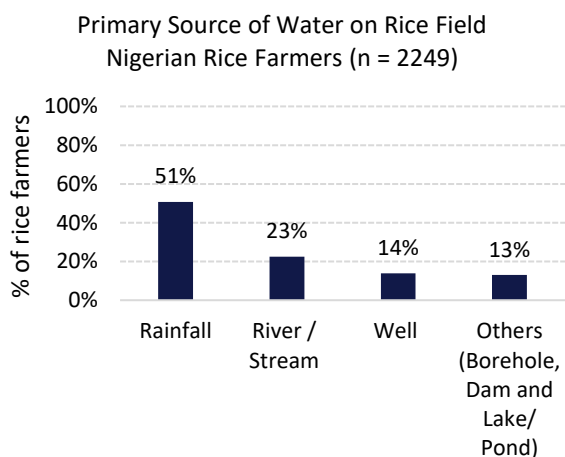


Figure 9: Main Source of Water on Rice Field Reported by Nigerian Rice Farmers

Source: Derftdan Farmer Survey 2022

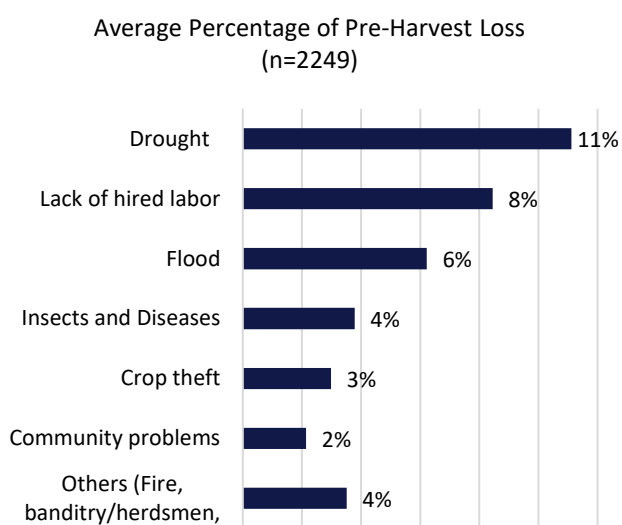


Figure 10: Average Percentage of Pre-Harvest Loss at Different Stages

Source: Derftdan Farmer Survey 2022

Nigerian farmers experience tremendous difficulties accessing mechanization.

Of the rice farmers surveyed, 79% said that it is either difficult or very difficult for them to access mechanization in their community. The difficulty faced in accessing mechanization varies over the state the surveyed farmer lives in. For example, 100% of farmers from Ebonyi and 98% of farmers from Kebbi said that it is either difficult or very difficult for them to access mechanization. About 54% of farmers from Jigawa said the same. The main reasons for difficulty accessing machinery are the high cost of mechanization, the low availability of equipment, and the rice farmers’ lack of knowledge of mechanization-related topics. Only 30% of rice farmers use machinery for their rice farming operations. Although 29% hire tractors, only 0.5% (12 farmers in total) own a tractor.⁴⁹

Nigerian farmers face a variety of pre-harvest challenges that lead to losses.

These include issues dealing with rodents, weather conditions (such as floods and droughts), crop theft, diseases, and more. 20% of the farmers surveyed reported experiencing pre-harvest losses. The sources of pre-harvest loss are summarized in Figure 10.

Nigeria is gradually closing the deficit in rice production, with critical opportunities remaining in the post-harvest and processing segments.

Rice is the third-most consumed staple food in Nigeria, with a per-capita consumption between 34 kg/year – 50 kg/year, and its demand has been growing.⁵⁰ Given the importance in the country, the government has put priority on boosting its production. The vast land available for rice production in Nigeria makes it a key opportunity country for the global expansion of rice production.⁵¹

⁴⁷ Okpiaifo, G., Durand-Morat, A., West, G. H., Nalley, L. L., Rodolfo M. N. Wailles, E. J. (2020). Consumers’ preferences for sustainable rice practices in Nigeria, *Global Food Security*, Volume 24, 100345, ISSN 2211-9124, <https://doi.org/10.1016/j.gfs.2019.100345>. (<https://www.sciencedirect.com/science/article/pii/S2211912419301786>)

⁴⁸ USDA and GAIN (2022). Grain and Feed Annual. https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_03-15-2021

⁴⁹ Derftdan Farmer Survey (2022)

⁵⁰ KPMG (2019). Rice Industry Review. <https://assets.kpmg/content/dam/kpmg/ng/pdf/audit/rice-industry-review.pdf>

⁵¹ Danbaba, N., Idakwo, P. Y., Kassum, A. L., Bristone, C., Bakare, S. O., Aliyu, U., Kolo, I. N., Abo, M. E., Mohammed, A., Abdulkadir, A. N., Nkama, I., Badau, M. H., Kabaraini, M. A., Shehu, H., Aboosedo, A. O., & Danbaba, M. K. (2019). Rice postharvest technology in Nigeria: An overview of current status, constraints and potentials for sustainable development. *OALib*, 06(08), 1–23. <https://doi.org/10.4236/oalib.1105509>. https://file.scirp.org/pdf/OALibJ_2019081215544369.pdf

Nigerian farmers are yet to fully adopt the buying of new and improved seeds. Most of them save grains from their harvest which they replant as seeds. Of the rice farmers surveyed, 72% source rice seeds from their farms. Only 8% buy from private seed companies and less than 1% source seeds from research institutes. Figure 11 shows an overview of where farmers source their rice seeds.

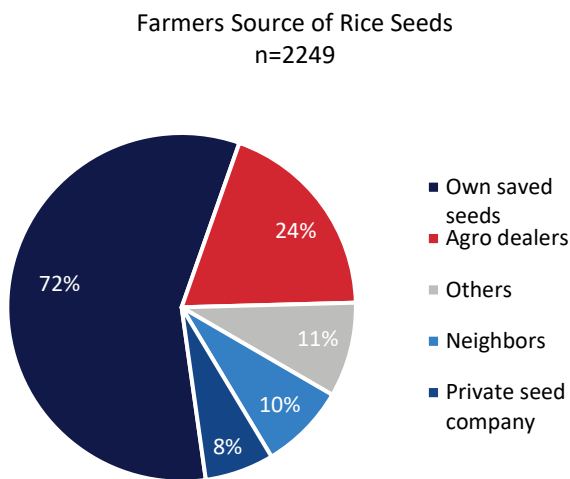


Figure 11: Overview of where farmers source their rice seeds
 Source: Derftdan Farmer Survey 2022
 Others include farmer friends in neighboring countries, research institutes, importation and the Ministry of Agriculture

FARO 44 is the preferred rice variety of choice for farmers across all eight states. It is the most used seed for rice farmers in Nigeria. Farmers prefer this seed because of its drought resistance and high-yielding properties. Other commonly used seeds are FARO 52, FARO 57, and FARO 66. Farmers who only used FARO 52 indicated a preference for it due to its high yielding and drought resistance properties in conjunction with its good taste and aroma. The prevalence of FARO 44 heavily depends on the state. Figure 12 depicts a breakdown of seed varieties used by farmers by state. FARO 44 is the most used rice seed variety in Cross River, Jigawa, Kebbi, Kano, Nasarawa, and Niger but less used in Ebonyi and Edo.

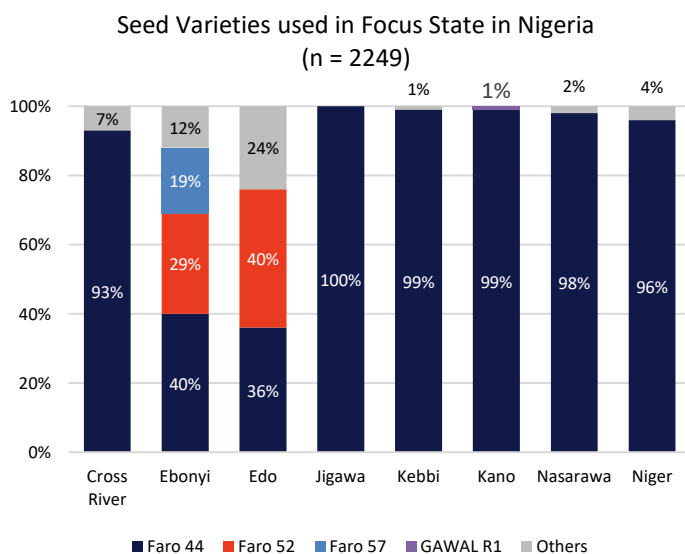


Figure 12: Seed Varieties used by State in Nigeria
 Source: Derftdan Farmer Survey 2022

3.2 Supply Chain Overview

The rice supply chain in Nigeria is long and fragmented with many actors operating in silos. The value chain is marked by many smallholder farmers, paddy traders, village and clustered parboilers and millers, and wholesale traders selling open-bag rice with little regard for quality and safety standards. Also, the limited coordination in the value chain across post-harvest and processing undermines the implementation of grades

and standards for rice quality.⁵² Although there is a reasonable amount of coordination in the production segment of the value chain, as evidenced by the government’s frequent collaboration with the Rice Farmers Association of Nigeria (RIFAN), there is a need to extend cooperation to other segments of the value chain. An overview of the stakeholders by category can be found in [Annex 1](#).

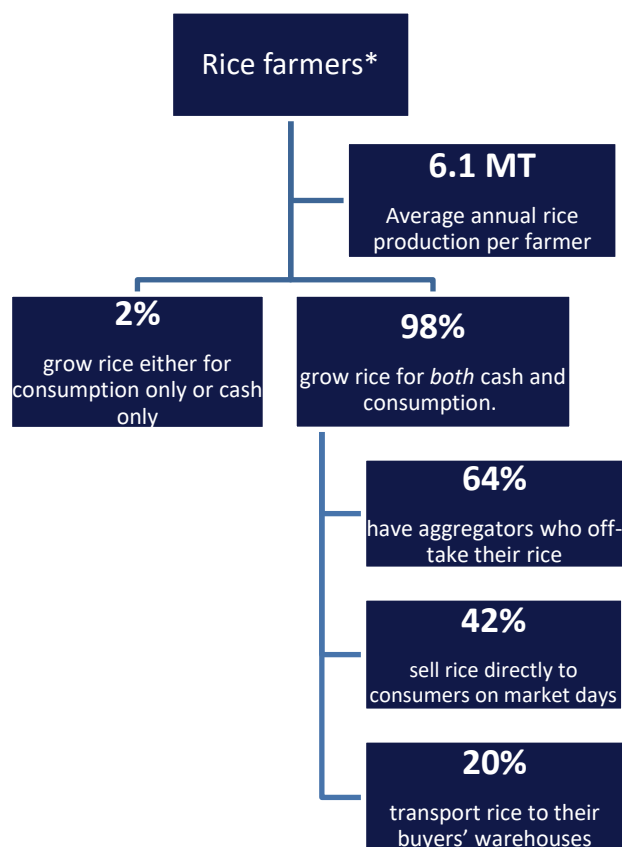


Figure 13: How Rice Farmers Connect with Buyers

Source: Derftdan Farmer Survey 2022.

*Percentages may add up to more than 100% as some farmers take a mix of approaches.

Aggregators and rice traders are the biggest off-takers of rice paddy. On average, rice farmers sell 38% of their paddy to traders and aggregators. Others sell 21% of their paddy to medium to larger processors and some sell 20% to cottage processors. Consequently, aggregators and traders are the biggest off-takers, collecting rice from 64% of rice farmers surveyed. 20% of rice farmers connect with paddy rice buyers by transporting rice to their buyers’ warehouses, and 42% only sell rice directly to consumers on market days (Figure 13).⁵³

The average volume of rice harvested per ha ranges from 1.4 MT per ha in Edo to 3.73 MT per ha in Jigawa (Figure 14). Rice farmers in Edo, Jigawa and Kano make more than the national average income per hectare (NGN 280,033 per ha) while farmers in Cross River make the least; NGN 148,743 per ha which is about 2X less than the national average (Figure 15). The reason while farmers in Edo make more income but harvest less rice per ha could be because they sell for one of the highest prices at off-season (Figure 16).

It seems the extra investments in expenses made by medium-sized rice farmers (with farm size between 3 ha and 5 ha) does not lead to a proportional increase in income. While the average annual income per ha made by a farmer from selling rice could vary from NGN 256,000 to 422,000 depending on the farm size, most farmers with farm size between 3 ha and 5 ha have less margins compared to subsistence (2 ha or

less) and commercial farmers (5 ha or more).⁵⁴ It could be that the additional expenses for a farm size between 3 ha and 5 ha is not optimal enough to translate to higher incomes. In addition, up to 19% of the rice value is lost irrespective of farm size during harvesting and post-harvesting due to lack of mechanized equipment for harvesting, ineffective storage methods and materials, and inefficiencies in processing activities (Figure 17).

⁵² Okpiaifo, G., Durand-Morat, A., West, G. H., Nalley, L. L., Nayga, R. M. & Wailes, E. J. (2020). Consumers’ preferences for sustainable rice practices in Nigeria. <https://doi.org/10.1016/j.gfs.2019.100345>

⁵³ Derftdan Farmer Survey, 2022

⁵⁴ Derftdan Farmer Survey, 2022

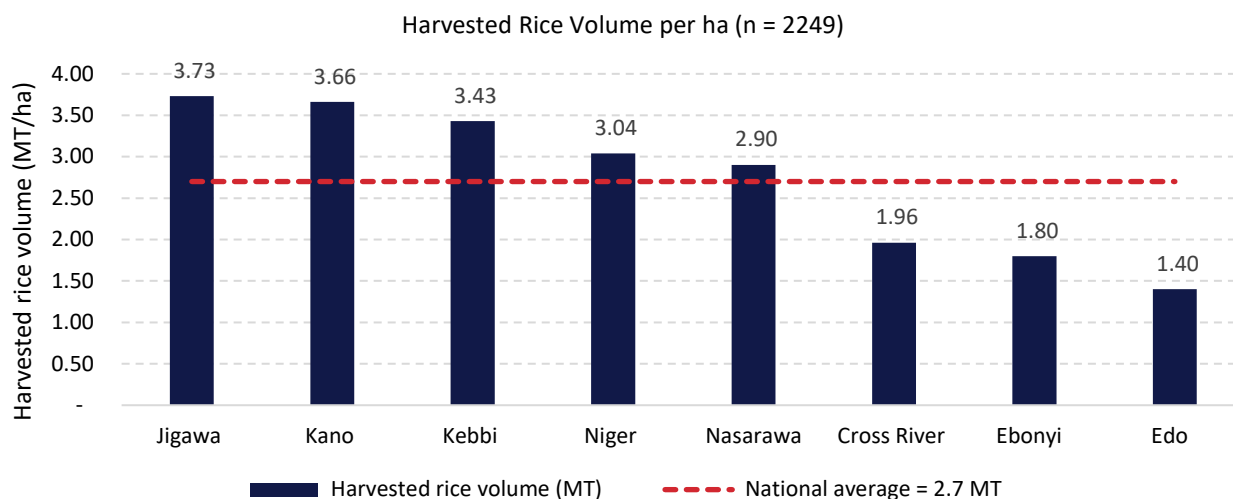


Figure 14: Harvested Rice Volume per ha across Study States

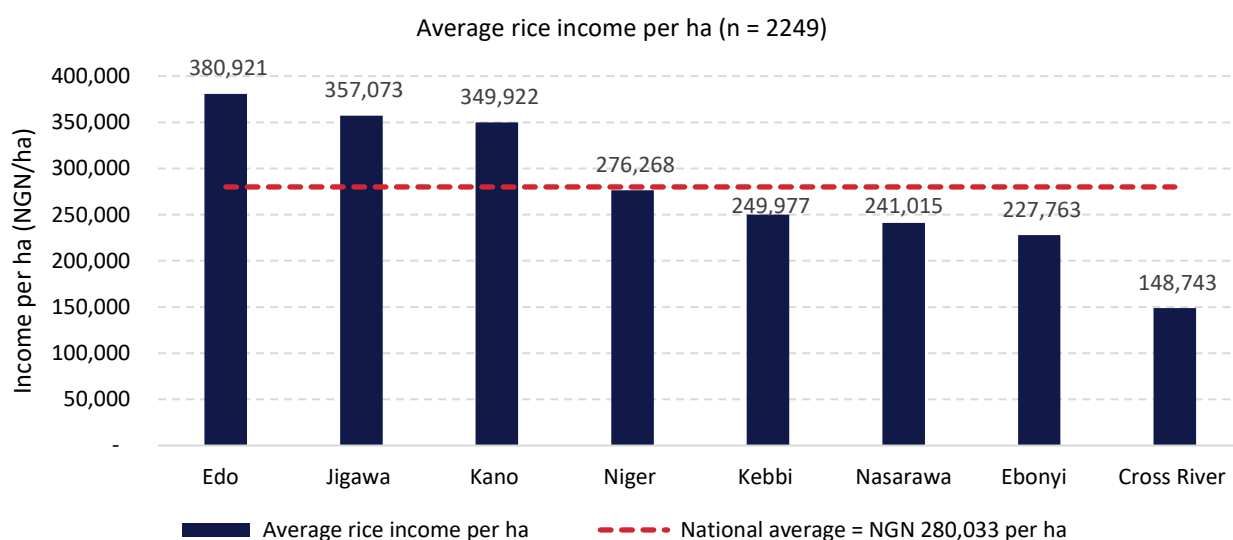


Figure 15: Average rice income per ha across Study States

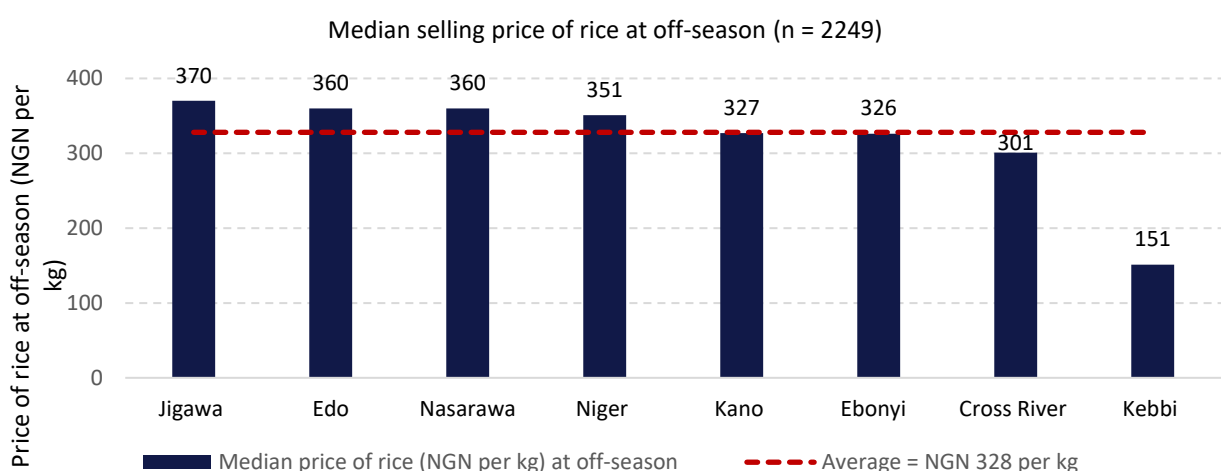


Figure 16: Median selling price of rice at off-season across Study States

Value addition through processing and storage for off-season sales are two key approaches to boost profitability in rice. Only 3 of the 22 groups in the FGDs conducted processed their rice into milled or parboiled

rice before selling. Their reason for processing before selling is to achieve more profits as processing adds more value to paddy. In addition, **farmers who store a portion of their rice for sale later during the off-season make slightly more income than those that sell all their paddy immediately upon harvesting.** 51% of rice farmers had rice stored for later sale. The total average annual income by farmers that store their paddy for later is NGN 1.2 million compared to NGN 1 million made by in-season sellers. Off-season sellers enjoy better prices as a kilogram of paddy could average around NGN 328 during the off-season while prices are around NGN 291 per kg during the in-season. Farmers do not often have many options but to sell immediately after harvesting due to the need to have some cash to support their livelihood and to prepare for farming for the next season. Also, a lack of effective storage facilities contributes to their limited options.

Cottage processors can unlock up to 21% more processing capacity compared with medium to large processors by adopting improved rice milling methods. 2 in every 3 cottage processors interviewed use traditional rice milling methods such as hand pounding in a mortar with a pestle. This method is wasteful and limited by the availability of labor. While medium to large processors faces challenges relating to securing enough supply, cottage processors do not. By switching to using improved rice processing methods such as the NCRI parboiler, cottage processors can unlock more processing capacity (Figure 18).

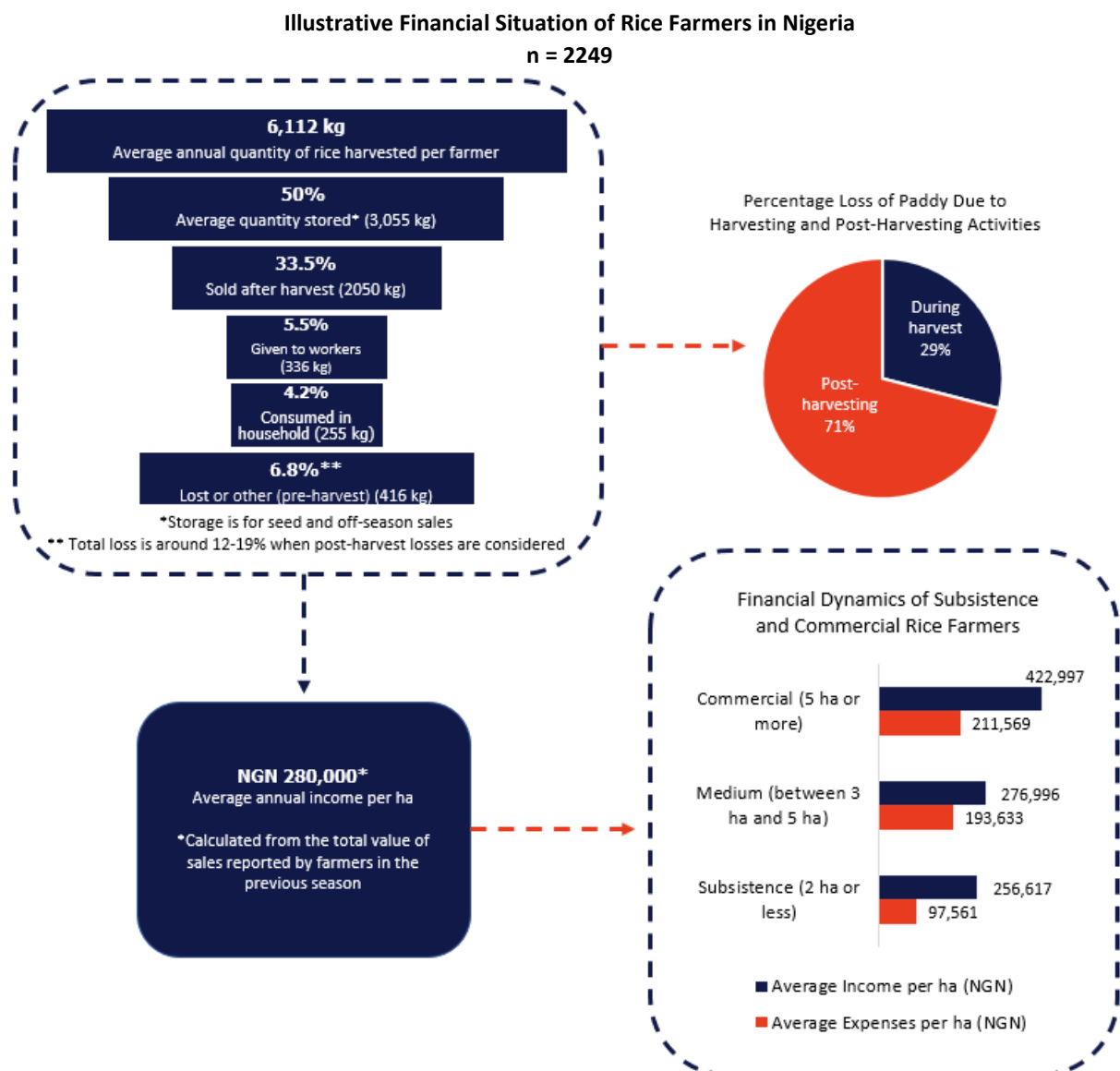


Figure 17: Financial Situation of Rice Farmers in Nigeria
Source: Derftdan Farmer Survey 2022; Derftdan Desk Research 2022

Illustrative Flow of Rice Among Buyers and the Capacity of Processors in Nigeria

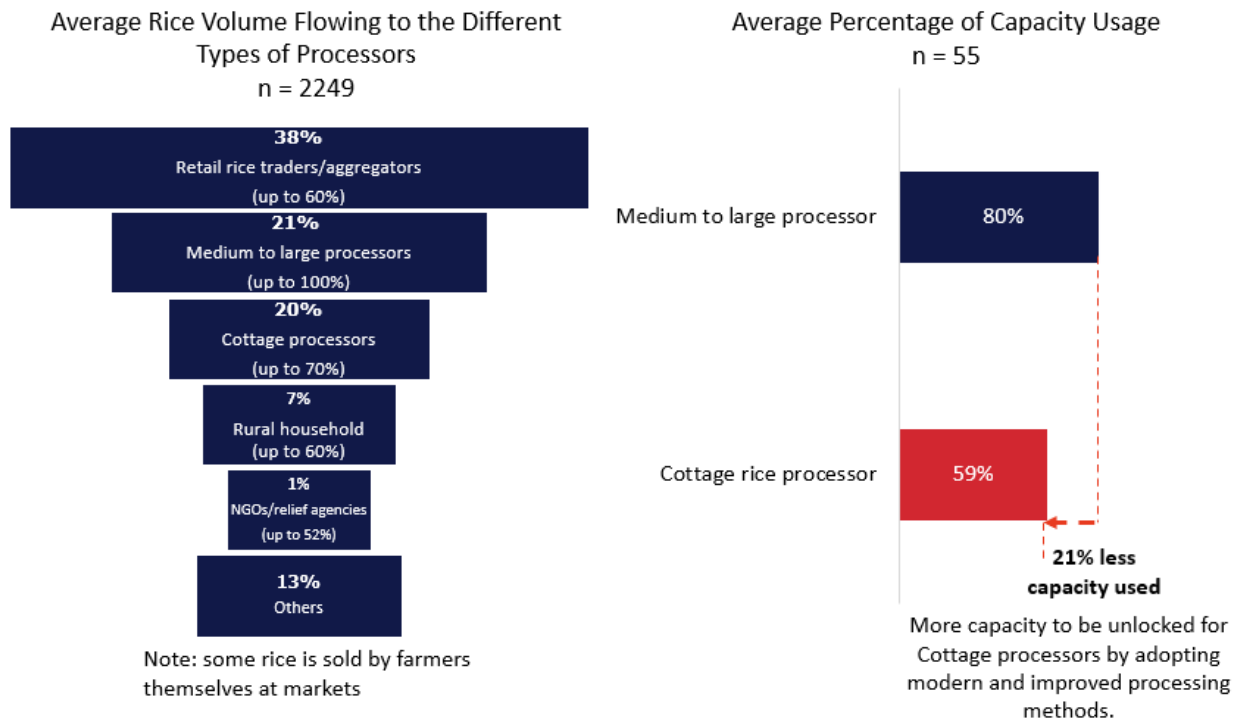
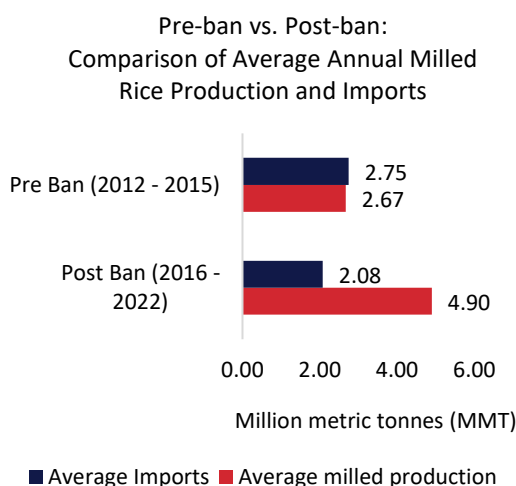


Figure 18: Illustrative Flow of Rice Among Buyers and the Capacity of Processors in Nigeria
Source: Derftdan KII 2022; Derftdan Desk Research 2022

3.3 Government's Role in Recent Rice Sector Developments



Average Annual Milled Rice Production and Imports
Source: USDA 2012 - 2022c

The ban on the importation of rice has increased local production and consumption of locally milled rice by over 100%. In 2015, the Federal Government of Nigeria (FGN) through the CBN placed a ban on the importation of rice by restricting importers from accessing foreign exchange to pay for rice imports.⁵⁵ Also, the FGN banned rice imports across land borders and kept 70% tariffs on imports coming through ports to further discourage rice importation.⁵⁶ Even as Nigeria signed the African Continental Free Trade Area (AfCFTA), expanding its potential for rice exports, it maintained import restrictions on rice.⁵⁷ The policies were aimed at improving the rice value chain by boosting local production and consumption of domestic rice. Despite these bans, Nigeria remains the third largest importer of rice in the world with over 2 MMT of rice

⁵⁵Foyeku, S. (2018). Rice import ban three years after. *Ships & Ports*. <https://shipsandports.com.ng/rice-import-ban-three-years/>

⁵⁶ Amata, D. (2022). *Nigeria Still Imports Rice and the CBN is Aware but have they told President Buhari?* Dataphyte. <https://www.dataphyte.com/latest-reports/agriculture/nigeria-still-imports-rice-and-the-cbn-is-aware-but-have-they-told-president-buhari/>

⁵⁷ International Trade Administration. (2021). *Nigeria - prohibited and restricted imports*. International Trade Administration | Trade.gov. <https://www.trade.gov/country-commercial-guides/nigeria-prohibited-and-restricted-imports>

currently being smuggled into the country annually.⁵⁸ There have been reported increases in rice exports to Nigeria's neighboring countries (Benin, Cameroun, Niger, and Togo) with lower import tariffs and porous borders.⁵⁹ Still, the ban remains popular as 11 of the 22 rice market actors who were aware of government action taken to support the rice industry believed that the most important policy direction for the Nigerian rice sector is to renew or strengthen the ban.⁶⁰ Regardless of the ban, the fact remains that parboiled long grain rice from major rice-producing countries has continuously entered the market through unauthorized routes from Nigeria's neighboring countries and is freely sold in informal open-air markets and neighborhood shops. Despite high tariffs, the government only collects a small percentage of intended tax revenue due to non-compliance and the existence of a complex network of canals used to illegally smuggle rice into Nigeria.⁶¹ Nigerians' preference for imported rice and the deficit in local production created a market gap of about 2.2 MMT in 2021 with an estimated 2.5 MMT in 2022. However, imported rice has not completely supplanted domestic rice, as evidenced by the fact that only 8 out of the rice market actors interviewed currently sell imported brands. Despite its failures to prevent rice from illegally entering Nigeria, the rice ban has facilitated the increase in Nigerian milled production by over 100% from 2.7 MT per annum in 2015 to 5 MMT in 2021 and is expected to increase to 5.5 MMT in 2022. Figure 19 shows how average milled production surpassed imports by more than a factor of two after the ban on rice imports.⁶²

Other notable government programs which targeted areas for improvement across the rice value chain with support from developmental organizations are summarized as follows:

Credit and input

USAID Maximizing Agricultural Revenue and Key Enterprises in Targeted Sites II (MARKETS II) was a 5-year agricultural project jointly funded by USAID and the Nigerian Government with the goal of facilitating improved access to credit and inputs for rice farmers in Nigeria. It supported private sector partners and 36,600 rice farmers in the northern (Kano, Jigawa, Sokoto, and Kebbi) and middle belt (Benue, Cross River, Enugu, Nigeria, FCT, Kwara, Ebonyi, and Anambra) rice regions. Between 2012 and 2017, farmers who were enrolled in the program and had rainfed land increased their net income by 244% and farmers on irrigated land reported income increases of 179%. Farmers also reported significant increases in yields, decision-making power and control over the use of their income.⁶³ Other programs with broad areas of effect include the IFAD-Nigeria Value Chain Development Project (IFAD-VCDP) and the AfDB-Nigeria Agricultural Transformation Agenda Support Program (AfDB-ATASP-1).

The Anchor Borrowers Program (ABP), implemented in 2015 by President Muhammadu Buhari, was designed to create a linkage between smallholder farmers and agro-processors. Its broad objectives are to improve access to finance and create jobs. The CBN recently invested NGN 57.91 billion in the program, and the governor of the CBN claimed that it had directly supported more than 4 million smallholders.⁶⁴

⁵⁸ Agency Report. (2021). *Two million metric tons of rice smuggled into Nigeria annually – Senate committee*. Premium Times Nigeria.

<https://www.premiumtimesng.com/news/headlines/498442-two-million-metric-tons-of-rice-smuggled-into-nigeria-annually-senate-committee.html>

⁵⁹ Uche M. N. (2019). Nigeria's Import of Wheat and Rice to rise. GAIN Report

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_NI2022-0005.pdf

⁶⁰ Derftdan Rice Key Informant Interview (2022)

⁶¹ Zhao, A. (2020). *On thin rice: Analyzing trade policy in Nigeria*. Berkeley.edu. <https://bpr.berkeley.edu/2020/11/15/on-thin-rice-analyzing-trade-policy-in-nigeria/>

⁶² Boluwade, E. (2022). *Grain and feed annual*. Usda.gov.

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_NI2022-0005.pdf

⁶³ Paul, N., Ilisa, G., Caryl, M. (2019). *USAID/NIGERIA MARKETS II EX-POST STUDY*. Chemonics.com. <https://www.chemonics.com/wp-content/uploads/2019/02/MARKETS-II-Ex-Post-Report-FINAL.pdf>

⁶⁴ Okon, D. (2022). *CBN: Anchor borrowers' programme gulped N57.9bn in two months*. TheCable. <https://www.thecable.ng/cbn-anchor-borrowers-programme-gulped-n57-9bn-in-two-months>

Production

The World Bank FADAMA series was a tripartite program with different focus areas. FADAMA I was designed to offer basic irrigation support to farmers. FADAMA II followed up on its predecessor's success by introducing a community-driven development model and helped institutionalize local stakeholder engagement in community decision-making. Finally, FADAMA III helped improve infrastructure to make the transport of goods easier. Institution building has been a major focus of these programs with 86,156 user groups and 6877 community associations being created across all three initiatives.⁶⁵ FADAMA III specifically has supplied farmers with 8,000 pieces of farm equipment, and 174 km of rural roads have been improved or constructed.⁶⁶

Capacity building

The Competitive Africa Rice Initiative (CARI) co-funded by the Bill and Melinda Gates Foundation, was formed to educate smallholders on ways to become self-efficient and implement climate-sustainable farming practices. Farmers part of their programs have reported income increases of up to 700%, and the program has trained 48,000 smallholders in their Sustainable Rice Platform (SRP) curriculum.⁶⁷

It is important to note that although the government has seen success in some of these programs, their reach appears to be limited, especially in the context of insurance. Of the 6 Financial Institutions interviewed, only one reported working with public, private, or development organizations to promote the uptake of insurance. Moreover, the institutions surveyed targeted most of their suggestions for improving the rice industry to the government, with one representative from a bank saying, “the government needs to get truthfully involved.”⁶⁸

⁶⁵ Jenane, C., & Oredipe, A. A. (n.d.). Delivering development: collaboration the key to success in Nigeria's FADAMA projects. World Bank Blogs. Retrieved October 4, 2022, from <https://blogs.worldbank.org/nasikiliza/delivering-development-collaboration-key-success-nigerias-fadama-projects>

⁶⁶ World Bank (2010). Fadama III Rural Agriculture Project Fast Becoming a Household Name in Nigeria.

<https://www.worldbank.org/en/news/feature/2010/07/28/fadama-iii-rural-agriculture-project-fast-becoming-a-household-name-in-nigeria>

⁶⁷ CARI (n.d) <https://www.cari-project.org/>

⁶⁸ Financial and Insurance Institutions KII, Derftdan(2022)

Box 1: Nigeria - Challenges and Opportunities for Government Agencies Involved in the Rice Sector

To address the various challenges experienced by rice market actors in Nigeria, government agencies in the rice sector are responsible for

- (1) Extension and advisory services for capacity building through various training (basic business training, good agricultural practices (GAP), Sustainable Rice Production (SRP), rice processing techniques).
- (2) Facilitating access to agri-finance.
- (3) Partnership and collaborations with supporting agencies to ensure steady growth and development in the sector.

Most of them claim to be fully equipped with effective strategies to fulfill their roles but factors such as **inadequate funding** for activities and staff mobility, **understaffed** with as low as 1 Extension Agent (EA) to 7000 farmers and sometimes old but experienced EAs, **information asymmetry** between sister ministries and agencies, and general **capacity building** for staff have a negative impact on their operations.

Recently, the Edo State Ministry of Agriculture allocated 9000 ha to commercial rice producers in the state while the Agricultural Development Authority of Edo is starting an annual value chain performance survey effective 2023 for M&E and effective data gathering on farmers, including rice farmers.

Ultimately, opportunities in the rice value chain for government agencies are in **ramping up production, securing investment and partnership** to support the sector, **strengthening processing and storage facilities** through infrastructure and technology, **facilitating synergy** between stakeholders in the sector, and **creating job opportunities** by employing more extension agents and making rice farming more attractive to farmers.

Source: Derftdan Rice Stakeholders KII (Derftdan 2022)

3.4 Other Interventions

Other organizations, including NGOs and international development organizations, have also intervened in the Nigerian rice market. Often, NGOs will partner with the government to achieve optimal outcomes in target areas. Below is a summary of three key projects executed by Extension Africa (ExaF), Precision Development (PAD) and TechnoServe (TNS). All information in the summaries comes directly from KIIs with ExaF, PAD, and TNS.⁶⁹

Extension Africa: Since 2009, ExaF has implemented a rice value chain development project. It will continue until 2025, and its objectives are to enhance productivity, provide value addition skills and improve the economic performance of the target farmers. Targeted beneficiaries are smallholder farmers in Kano State. Kano State was chosen specifically for its potential in rice production despite limited knowledge among farmers. 15% of the beneficiaries are women and 42% are youth. The top three findings were that farmers have limited extension services, inadequate knowledge, and very few organized markets. The top achievements of the project were that farmers were organized to work in groups, more women farmers were integrated into the production process, and farmers were given links to other key market actors.

Precision Development: PAD has implemented a Rural Poor Stimulus Facility program. The program will run from 2020 to 2022. The goal of the program is to increase production output and thus the domestic supply of rice in Nigeria. To this end, it will provide agricultural stimulus and resilience package for smallholders in Northern Nigeria to support production activities. The program targets smallholders due to their vulnerability to the effects of COVID-19. 28% of the beneficiaries are women and 35% are youth. It was implemented in Ebonyi, Kebbi, Sokoto, and Ogun. The top three findings of the program were that smallholder farmers do not have access to the right inputs for rice production, only about 52% of Rice farmers in Nigeria do have access

⁶⁹ Implementing Partners KII, Derftdan (2022)

to extension services, and smallholders are willing and able to use digital extension platforms. The major achievement of the program was that it successfully developed and piloted a digital agriculture extension system for over 52,000 farmers.

TechnoServe: TNS has implemented two separate rice programs in Nigeria: Project Jolof (from 2017 to 2018) and the Business Women Connect Project (from 2018-2021). The goal of these programs was to increase economic opportunity for women rice farmers in rural Northern Nigeria. The targeted beneficiaries were Women Small Holder Farmers at the rural level. The reason the program was focused on women was to improve gender inclusion in Agribusiness practices such as rice production and processing. They were able to focus on women, with over 70% of the beneficiaries being female. The program was implemented in the Kaduna, Kano, and Jigawa States. The top finding of the BWC program was that women's inclusion in agricultural production is very low. Although women make up to 75% of farm labor in rural communities, they are 24% to 32% less than men per hectare of land cultivated. This is because women lack access to land, technical and agribusiness skills, and technology. The top accomplishment of the BWC program was that it laid the foundations to address the challenges facing women's participation in agriculture by ensuring hundreds of women were trained. This will help them impact more in their communities, and ideally nurture the growing community of women farmers in Nigeria.

3.5 External Factors Impacting the Nigerian Rice Industry

The two most important external factors impacting Nigeria in recent times were COVID-19 and more recently, the Russia-Ukraine war.

The COVID-19 pandemic negatively impacted the entire rice value chain in Nigeria in 2019/2020; Nigeria is slowly recovering from disrupted access to hired labor, inputs, and distribution. The impact of the pandemic on rice production in Nigeria was severe because of the economic lockdown and movement restrictions which affected the 2019/2020 harvesting season as well as the 2020/2021 land preparations and planting season.⁷⁰ The restrictions led to the shortage of hired labor for farming activities including harvesting which resulted in high post-harvest losses for farmers. These were exacerbated by an increased difficulty in accessing farming inputs.⁷¹ The restrictions also led to a decline in household incomes which further constrained rice consumption by low-income households across the country. Further, the movement restrictions and the associated price volatility caused supply problems for the local rice millers which needed high volumes of paddy to feed their mills. These supply problems were worsened by the problems with distributing milled rice to wholesalers, retailers, or final consumers. One of the stakeholders interviewed for this study shared that during the pandemic they had to source paddy outside the country due to increased rice demands. However, the World Bank reported in early 2022 that the Nigerian economy was gradually transitioning to full recovery due to the discontinuation of COVID-19 restrictions.⁷²

The Russia-Ukraine war is raising the prices of fertilizers and other farming inputs globally. Russia and Ukraine are among the top producers of agricultural commodities in the world. Russia is the largest exporter of nitrogen fertilizers and the second leading supplier of both potassic and phosphorous fertilizers globally.⁷³ Many African countries, including Nigeria, depend on imported fertilizers to meet the farmers' demands. For

⁷⁰ Esiobu, N. S. (2020). How does COVID-19 pandemic affect rice yield? Lessons from, southeast Nigeria. *Journal of Biology, Agriculture and Healthcare*, 10(15), 38–56. <https://doi.org/10.7176/jbah/10-15-06>

⁷¹ Idu, M. A., & Onyenekwe, C. S. (2021). Mitigating COVID-19 effects on farmers: The role of commissioners of agriculture in Nigeria. *Agro-Science*, 20(4), 65–69. <https://doi.org/10.4314/as.v20i4.9>

⁷² USDA and GAIN (2022).

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_NI2022-0005.pdf

⁷³ FAO (2022). The Importance of Ukraine and The Russian Federation for Global Agricultural Markets and The Risks Associated With the War in Ukraine. <https://www.fao.org/3/cb9013en/cb9013en.pdf>

example, Nigeria planned to import about 35,000 MT of potash from Russia by June 3, 2022, and another 70,000 MT from Canada on June 6, 2022, to augment local production.⁷⁴ However, the conflict between Russia and Ukraine is already having a negative effect on the prices of fertilizer and other inputs and international food. International fertilizer prices have increased sharply. For example, the prices of fertilizer increased by 30% since the beginning of 2022.⁷⁵ Prior to the conflict, rice farmers in Nigeria were already experiencing rising prices. The already bad fertilizer situation was worsened by the impact of the Russia-Ukraine war. Currently, a bag of NPK fertilizer and Urea costs over NGN 20,000 (USD 48.18) in the retail market compared to December 2021 when it was sold between NGN 12,500 and 15,000 (USD 30.11 - 36.13).^{76,77} Farmers are becoming more worried about the accessibility and affordability of fertilizer due to lingering price increases and its impact on their production. Also, some of the seed companies interviewed during the KIIs noted that the high cost of inputs, such as fertilizer, has increased their cost of seed production.

⁷⁴ Olisah, C. (2022). Food crisis: Nigeria to import 105,000 tonnes of fertilizer raw material from Russia, Canada. Nairametrics. <https://nairametrics.com/2022/05/26/food-crisis-nigeria-to-import-105000-tonnes-of-fertilizer-raw-material-from-russia-canada/>

⁷⁵ Baffes, J., & Koh, W. C. (2022). Fertilizer prices expected to remain higher for longer. World Bank Blogs. Retrieved October 4, 2022, from <https://blogs.worldbank.org/opendata/fertilizer-prices-expected-remain-higher-longer>

⁷⁶ This Day Live (2022). <https://www.thisdaylive.com/index.php/2022/05/02/bracing-for-the-looming-food-crisis/>

⁷⁷ Guardian (2021). Rising price of fertilizer jolts farmers. <https://guardian.ng/features/rising-price-of-fertilizer-jolts-farmers/>

4. Rice Post-harvest and Processing in Nigeria



Key Takeaways

1. Nigeria's rice sector is projected to grow by 21% in 2025 from USD 5.2 billion to USD 6.3 billion.
2. Nigeria can save an estimated USD 180 million in foreign exchange by fixing the inefficiencies in the rice processing sector.
3. For the post-harvest/processing segment of rice to improve, value chain actors need to have access to finance, switch to large-scale mechanized processing, and adopt sustainable practices.
4. Knowledge and techniques regarding post-harvest processing are lacking in Nigeria, thus reducing the overall quality of Nigerian rice.

4.1 Outlook of Nigerian Rice Post-harvest and Processing

Nigeria's rice sector is projected to grow by 21% in 2025 from USD 5.2 billion to USD 6.3 billion.⁷⁸

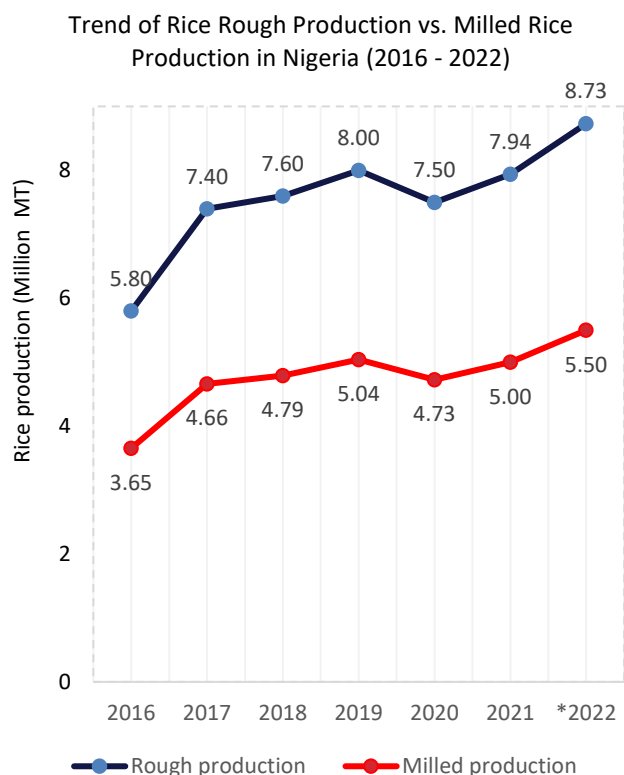
Contributing factors are rising population, increase in demand for rice, and overall growth in the economy. The economy is expected to grow by 2.9% in 2022 if further depletion in foreign reserves is avoided and crude oil prices are stable.⁷⁹ On the other hand, rice importation is expected to increase by 12% in 2023 because of the upcoming national elections and the corresponding political campaigns where prospective office holders will give away bags of rice to potential voters as part of their campaign activities. Normal rice market conditions will likely return in the country starting from late 2023 with the caveat that unforeseen events, such as a worsening of the Russia-Ukraine war or a new wave of COVID-19, could delay that timeline. To increase the likelihood of the projected growth in the economy and the rice sector, Nigeria can harness the opportunity to conserve foreign reserves by mitigating the inefficiencies in the rice processing sector (Figure 20). Ideally, milled rice is 68–72% of the rough rice produced. Nigeria typically achieves 63% signifying that up to 9% of the paddy is lost during processing to inefficiencies.

The increased adoption of sustainable practices, mechanization, and access to finance are key enablers of increased rice production and processing. However, mechanization has high capital requirements. Numerous small-scale processing facilities for milling and threshing are scattered across the country and they face challenges such as low turnover, unavailability of power, and labor shortages which further keeps them from scaling and affording machinery. However, if value chain actors are given co-investment opportunities and assistance covering the high upfront cost of buying equipment, they will not only have the collective power to purchase machinery but will also save cost, labor, and recoup investment relatively quickly.⁸⁰ Training them on how to maintain and store the equipment and, more importantly, how to extract optimal value from the machines will improve the rice processing sector both in terms of technical know-how and total revenue.

⁷⁸ Guardian (2019). <https://www.pressreader.com/nigeria/the-guardian-nigeria/20191208/282235192534849>

⁷⁹ African Development Bank (2022). Nigeria Economic Outlook. <https://www.afdb.org/en/countries-west-africa-nigeria/nigeria-economic-outlook>

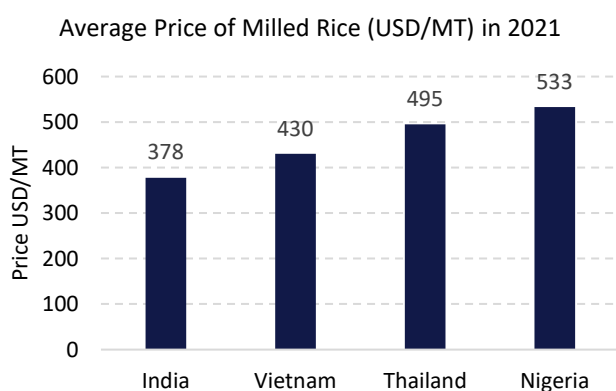
⁸⁰ dr.ir. J.M. (Han) Soethoudt, dr.ir. J. (Jan) Broeze, H.B. (Heike) Axmann MSc. 2021. The impact of mechanization in smallholder rice production in Nigeria



- There is an upward trend in the amount of paddy produced (rough rice) and the amount of milled rice in Nigeria over the past 5 years.
- According to International Rice Research Institute (IRRI), 68–72% of the rough rice produced will be milled rice depending on the efficiency of the milling process and the variety of rice.
- Nigeria typically achieves 63% as milled rice signifying that up to 9% of the paddy is lost during processing due to inefficiency.
- As Nigeria spends upwards of USD 2 billion on rice importation annually, closing this inefficiency gap can save an estimated USD 180 million in foreign exchange thus conserving national foreign reserves.
- In addition, the fund could be reinvested back into the rice processing sector to increase the capacity of existing processors and further improve operations.

Figure 20: Trend of Rice Rough Production vs. Milled Rice Production in Nigeria (2016 - 2022)

Source: IRRI 2022. *2022 = forecast



4.2 Overview of Harvesting and Processing in Nigeria

The average price of milled rice in Nigeria is higher than in other rice-producing countries like India, Thailand, and Vietnam (Figure 21).⁸¹ According to processors during the KIIs, the average cost of local milled rice varieties could be twice as much as that of imported milled rice varieties (Figure 22). The price of milled rice is expected to increase further in Nigeria as local millers are currently battling the increasing cost

of diesel, petrol, and unstable electricity supply. The top three challenges encountered during processing as shared by rice processors during the KIIs include unavailability of power, high cost of diesel, and equipment breakdown during production. This has led to an increase in the cost of processing rice at the local mills and is gradually increasing the price of the final product in the market.

Figure 21: Average Price of Milled Rice in India, Thailand, Vietnam and Nigeria

Source: USDA 2021, All Africa 2022

⁸¹ USDA (2021). Global Market Analysis. <https://apps.fas.usda.gov/psdonline/circulars/grain-rice.pdf>

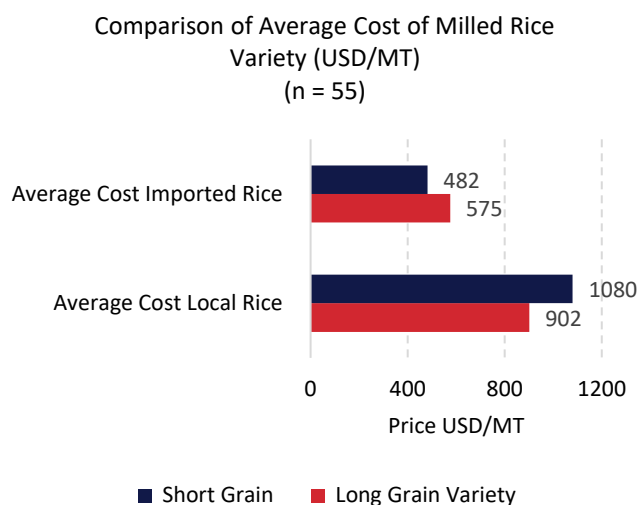


Figure 22: Comparison of Average Cost of Milled Rice Varieties in Nigeria

Source: Rice Stakeholders KII, Derftdan 2022

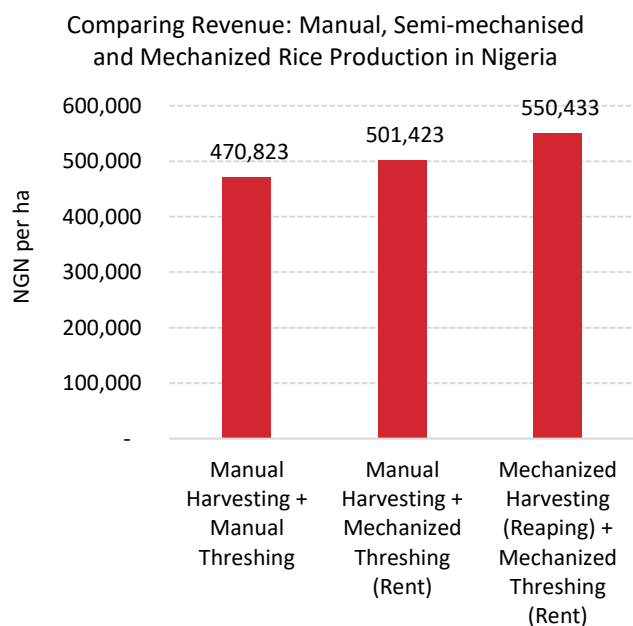


Figure 23: Manual and Mechanized Rice Production in Nigeria: Comparing the Cost of Production and Revenue

Source: dr.ir. J.M. (Han) Soethoudt, dr.ir. J. (Jan) Broeze, H.B. (Heike) Axmann MSc. 2021. The impact of mechanization in smallholder rice production in Nigeria

In Nigeria, while renting reapers and threshers for processing rice can increase production cost per hectare by 12.6%, it ultimately leads to a 17% increase in revenue. Most Nigerian farmers harvest their rice manually, using sickles and knives. The country average for the use of mechanization is 6.6%; it is highest in Edo (24%) but non-existent in Ebonyi. Low adoption of mechanization amongst individual farmers is due to the high upfront cost of buying mechanized equipment and low awareness of its benefits. However, buying becomes a cost-effective option if the cost is spread among a cooperative or group of farmers over a few harvests.⁴⁶ The amount of time saved upon adopting mechanized equipment is another key point to consider. Almost 85% of time-savings are achieved per farmer (203 hours) by switching from complete manual harvesting to mechanized (Figure 25). Another factor that influences competitiveness is value-addition. Producing value-added rice products is more profitable than rice milling. The economics of rice processing systems in Nigeria is such that there is a bigger profit margin in further processing of basic milled rice into value-added rice than in the processing of paddy rice into basic milled rice (Figure 23).⁴⁷

The rice milling industry in Nigeria comprises more cottage rice processors than industrial processors. Out of the 55 rice processors interviewed during the KII, 38 are cottage rice processors. 31 out of the 55 processors interviewed used traditional parboiling methods during processing due to their efficiency, availability, and affordability. Still, local processors often cannot supply as much rice to traders as industrial processors. 26 out of 50 of the market actors interviewed got their major supply of rice from distributors/dealers/wholesalers in the local market as opposed to local processors.

Sourcing rice paddy all year round is possible but often difficult. Rice processors often source paddy

differently. To ensure all year-round production, processors will need to have access to paddy. Out of the 55 processors interviewed during the KIIs, 22 sourced paddy from contract farmers, 22 sourced from regular farmers, 15 sourced from traders, and the remaining sourced from open markets, aggregators, their farms, and neighboring countries. Almost all the processors interviewed can source paddy all year round however, this is often difficult as farmers do not produce all year and they sometimes do not get the quantity they

require. Figure 24 depicts a comparison and contrast figure of key features of cottage and industrial processors.

Cottage vs Industrial Processors
Comparing and Contrasting Key Features
 n= 55









	Cottage Processors	Industrial Processors
 Average quantity of rice processed annually (MMT)	4.5	22.8
 Average annual sales of milled rice (million NGN)	131	353
 Experience Milling Rice (Years)	16.5	5
 Most Commonly Used Processing Technology	Traditional Pots	NCRI Par-Boiler
 Estimated Start-up Capital (million NGN)	3.8	6,500
 Percent of Rice Sold and Consumed Locally	92%	88%
 Major Rice Customers	Retailers & Wholesalers	Wholesalers Only
 Percent of Rice Paddy Sourced from State of Operations	71.5%	31%

Figure 24: Comparison between Cottage and Industrial Processors
 Source: Rice Stakeholders KII, Derftdan 2022

Time Investment on Harvesting and Threshing Rice
(hours/ha)

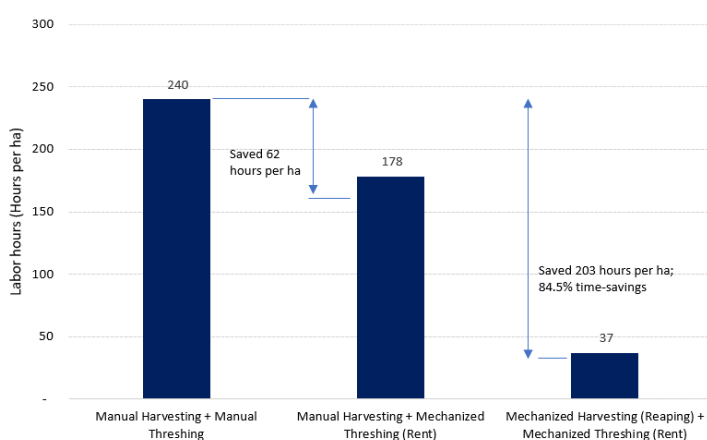


Figure 25: Labor Hours for Harvesting and Threshing Rice

Source: dr.ir. J.M. (Han) Soethoudt, dr.ir. J. (Jan) Broeze, H.B. (Heike) Axmann MSc. 2021. The impact of mechanization in smallholder rice production in Nigeria

and consumption).⁸⁵ Of the rice farmers in Nigeria that store their rice, 32% complain that the storage method and material are not effective and of low quality. This results in insects being noticed in many of the bags used to store and the rice growing molds and coagulating. In contrast, in developed countries like China, grain losses in the middle stage of the supply chain are relatively low due to advanced technologies and effective crop processing and storage systems.⁸⁶ Although private grain silos do exist, the Chinese Government often directly invests money in silos, either through contractors or a state-owned enterprise. For example, Sinograin, a state-owned enterprise, has announced plans to build 120 storage facilities in 18 provincial administrations.⁸⁷

Storage is an important aspect of the post-harvest and processing segment in Nigeria.

Across all the stakeholders interviewed during the KIIs, improving storage facilities and technology was mentioned as the most important aspect of rice post-harvest and processing supply chain to be improved in Nigeria. Post-harvest loss of grain is severe, and most rice farmers store their produce for an average of 4.5 months before selling due to several factors. Storing for too long ties cash down but is required to maximize profit during the off-season. In addition, storage is usually done under poor conditions with limited knowledge and technology of post-harvest management.^{82,83,84}

Almost 60% of rice farmers surveyed store their harvested rice to access better prices during off-season sales (the rest store rice primarily for seeds

4.3 Channels of Rice Distribution

Rice post-harvest and processing in Nigeria is characterized by many traditional farmers and small-scale rice mills scattered throughout the country, with a handful of professionally integrated supply chains supported by international buyers. In Nigeria, there are essentially five different channels that supply rice to Nigerian consumers across the value chain (Figure 26). The following describes these channels and provides a brief history and current situation of each.

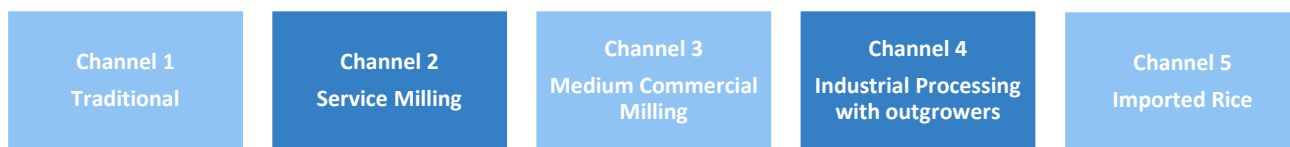


Figure 26: Channels of Rice Supply to Customers in Nigeria

Source: Derftdan 2022

⁸² Tefera, T.; Kanampiu, F.; De Groot, H.; Hellin, J.; Mugo, S.; Kimenju, S.; Beyene, Y.; Boddupalli, P.M.; Shiferaw, B.; Banziger, M. The metal silo: An effective grain storage technology for reducing post-harvest insect and pathogen losses in maize while improving smallholder farmers' food security in developing countries. *Crop. Prot.* 2011, 30, 240–245

⁸³ Dowell, F. E. Dowell, C. N. (2017). Reducing grain storage losses in developing countries. *Qual. Assur. Saf. Crops Foods* 2017, 9, 93–100

⁸⁴ Ashish, M. Paschal, M. and Ajay, S. (2018). An Overview of the Post-Harvest Grain Storage Practices of Smallholder Farmers in Developing Countries. *Agriculture* 2018, 8, 57

⁸⁵ Derftdan Farmer Survey (2022)

⁸⁶ Kumar, D. and Kalita, P. (2017). Reducing Post-harvest Losses during Storage of Grain Crops to Strengthen Food Security in Developing Countries. *Foods* 2017, 6, 8.

⁸⁷ World Grain (2021). China to increase grain storage capacity. <https://www.world-grain.com/articles/15538-china-to-increase-grain-storage-capacity>

Channel 1: Traditional serves the rural village market and is supplied by traditional farmers, who largely produce for their consumption but sell what surpluses they have to the rural village market.

Channel 2: Service Milling The large number (estimated thousands) of small-scale rice mills that are scattered throughout the rice-growing regions are a challenge for the industry. Rice normally changes hands at least four times en route to the end market and possibly undergoes two types of service provision: parboiling and milling. This channel is characterized by a speculation and trading mentality as the product moves up the value chain. There is relatively little investment made by any of the actors along the chain (a low-risk strategy equates to a low input-low output cycle).

Channel 3: Medium Commercial Milling serves the middle-end urban market and includes medium-sized mills. Nigerian rice milled production increased from 2.7 MMT per annum in 2015 to 5 MMT per annum in 2021. The number of integrated rice mills jumped from 10 to above 60 mills during the same period. Dangote Rice industries are set to commission its flagship rice mill plant in Jigawa State later in the year. The rice mill has the capacity to produce 70,000 MT per year. In addition, Dangote Rice is also installing processing mills in several states, including Kebbi, Sokoto, Zamfara, Kano, and Niger States. These mills are forecasted to jointly produce 700,000 MT of rice annually. The scarcity of rice paddy is a major challenge for rice milling companies across the country as most of these mills operates below 50% milling capacity.

Channel 4: Industrial Processors with Out-growers. These are large-scale directed industrial mill channels targeting import substitution with high-quality locally grown rice. In 2009 there were only two mills in this channel: Olam and Veetee. Due to the FGN's industrial mill initiative, between 2015 and 2021, at least 58 integrated rice mills have been created. Currently, there are over 68 integrated mills spread across the country with a combined capacity of three MMT.⁸⁸

Channel 5: Imported Rice 2022/2023 imports are expected to be 2.5 MMT.⁸⁹ Consumption growth is partially satisfied by a larger domestic crop. Currently, Nigerian rice consumers still prefer parboiled long grain rice from Thailand and India, which continues to enter the Nigerian market through grey channels (unofficial routes) and are freely sold in the dominant traditional open-air markets and street/corner shops. Long grain foreign rice usually sells for about N28,000 for a 50kg bag.⁹⁰ In 2021/2022, Nigerian rice millers reportedly started sourcing paddy rice from Benin and Burkina Faso.⁹¹

⁸⁸ Guardian (2022). CBN facilitates over 58 new rice mills as farmers, others list challenges. <https://guardian.ng/features/cbn-facilitates-over-58-new-rice-mills-as-farmers-others-list-challenges/>

⁸⁹ USDA and GAIN (2022).

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_NI2022-0005.pdf

⁹⁰ Guardian (2022). Rice sellers worry as price increases in Lagos. <https://guardian.ng/news/rice-sellers-worry-as-price-increases-in-lagos/>

⁹¹ USDA and GAIN (2022).

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_NI2022-0005.pdf

4.4 Key Challenges: Rice Post-harvest and Processing in Nigeria



Key Takeaways

1. Significant post-harvest losses reduce overall rice production in Nigeria and lowers rice quality.
2. Low yields, caused by various production challenges, hurt the consumption, processing, and production of rice.
3. Lack of effective storage facilities, impractical method of estimating post-harvest loss, traditional processing methods, and other related factors affect the development of the value chain.

In addition to challenges during production and harvesting, stakeholders and key actors across the rice value chain encounter challenges during the production and processing of rice. Figure 27 highlights six of these challenges.

Figure 29 at the end of this section summarizes challenges faced by all actors in the Nigerian rice value chain.

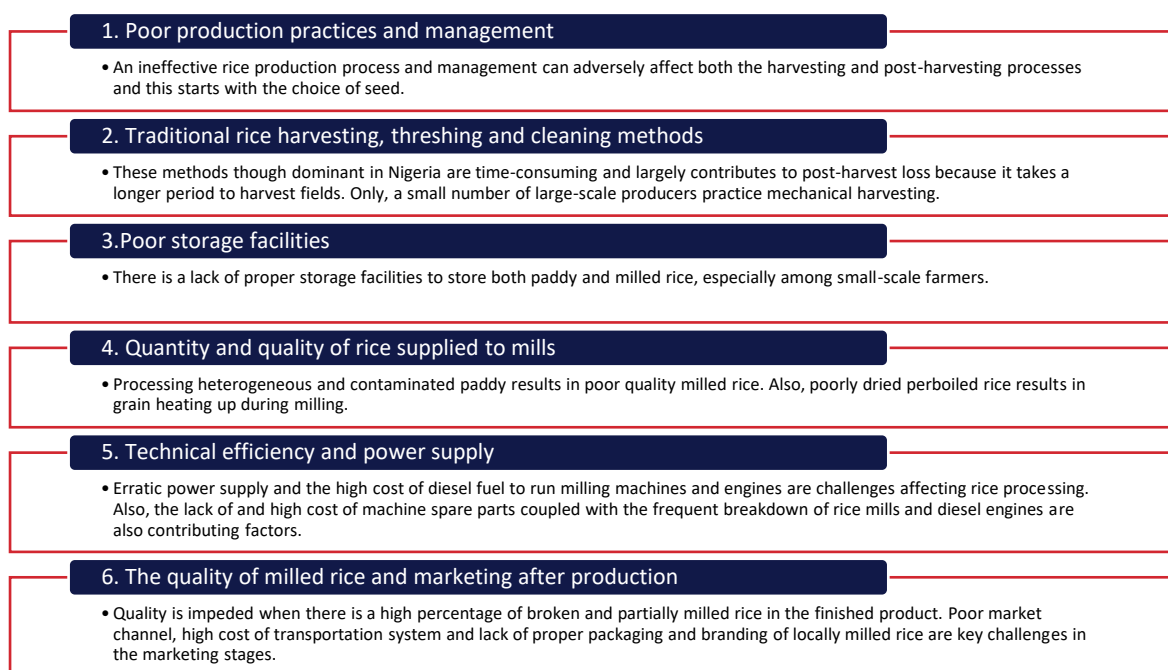


Figure 27: Six Key Challenges across the Nigerian Rice Post-Harvest Value Chain

Sources: Derftdan Desk Research, 2022; Danbaba *et al* 2019.

Nigerian farmers experience significant post-harvest losses in rice quantity and quality. These losses span across harvesting and post-harvesting processes. 15% of the farmers surveyed lose paddy when threshing and winnowing with up to 27% of the total loss attributed to threshing. Figure 28 shows the stages of losses at each stage of harvest and post-harvest.⁹² Farmers who harvested manually with sickles and knives recorded a higher percentage of loss.

⁹² Derftdan farmer survey (2022)

Average Percentage Loss of Paddy Rice Experienced Across Harvesting Operations (n=2249)

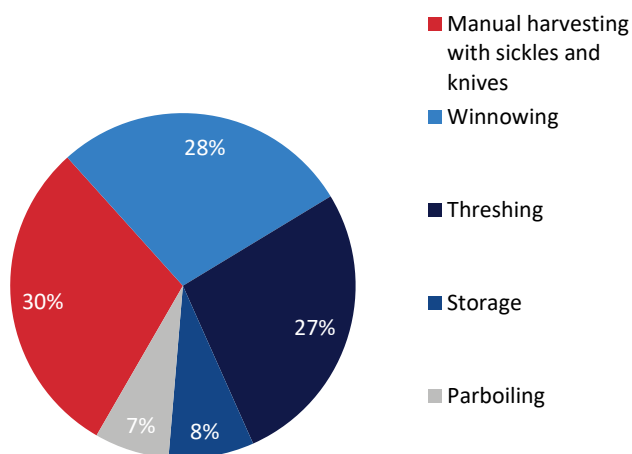


Figure 28: Average Percentage Loss of Paddy Rice at Different Stages of Harvest and Post-Harvest in Nigeria
Source: Derftdan Farmer Survey 2022

Biological deterioration is also a key post-harvest challenge that causes loss in rice quantity and quality. It is dependent on several environmental factors, including temperature, relative humidity, air velocity, atmospheric composition (concentration of oxygen, carbon dioxide, and ethylene), and sanitation procedures. When paddy or milled rice is not properly handled stored deterioration is inevitable. Of the 50 rice market actors interviewed, 26 people experienced the losses most during the rainy season and 7 of them specifically cited poor storage facilities which allow mold to infect stored rice.⁹³

Low harvest yield affects production, processing, and consumption. Although Nigeria is one of the biggest rice producers in Africa, the production of rice in Nigeria has not met up with

consumption because of low harvest yield. Nigeria's rice yield is one of the lowest globally. Low yields are due to production challenges such as low mechanization, limited supply of agrochemicals, insect pests, poor logistics, fungal and bacterial diseases, poor management practices, inadequate storage facilities, and inadequate funding. The absence of specialized service providers in the value chain also negatively impacts production.

Post-harvest losses have contributed significantly to Nigeria's inability to attain self-sufficiency in local food production. Efforts to identify and resolve post-harvest issues along the rice value chain in Nigeria are impeded by the lack of a simple and well-defined practical methodology for estimating post-harvest losses. Not only do these losses threaten food and nutrition security in the country, but they also increase the cost of production and slow down the marginal increase in yield recorded at the farm level. The percentage of loss varies widely from farm to farm. A study measuring losses in the rice supply chain of Olam found losses ranging from 8% up to 55%.⁹⁴ More specifically, research showed that the shattering of grains happens in the field before and during harvest thus affecting rice quality. At secondary postharvest levels, rice parboiling process, an essential pre-treatment given to paddy rice before milling accounted for 5.19% paddy loss. While only 2.4% of rice farmers have some level of waste due to inefficient milling centers, 98% of those farmers either process their paddy at local milling centers or manually process it at home, indicating that milling at the village level is wasteful.⁹⁵

There exists no simple and well-defined practical methodology for estimating post-harvest loss across the rice value chain. Such a methodology would provide deeper insights into the best practice for nationwide adoption which would reduce post-harvest loss. When constructing this methodology and analyzing post-harvest losses in general, it is important to note that the levels and causes of post-harvest grain losses vary with the different post-harvest stages and grain varieties.⁹⁶

⁹³ Rice Stakeholders KII, Derftdan (2022)

⁹⁴ Kok, M. G. and Snel, H. (2019). Food loss measurements in the rice supply chain of Olam Nigeria; Analysis of the pilot study results. Wageningen University & Research. Report WCDI-19-084 / WFBR-2000. Wageningen.

⁹⁵ Derftdan farmer survey (2022)

⁹⁶ Derftdan Farmer Survey (2022)

Summary of the Top Challenges Faced by Nigerian Value Chain Actors

Pre-Production

Agro-dealers and Input Suppliers

- Lack of a certification system
- Farmers are unable to afford the inputs they provide
- Lack of capital to fund their services and activities

Seed Companies

- Insufficient finances to purchase seed varieties
- Inability of farmers to afford seeds
- Difficulty transporting seed, especially in large quantities

Research Institutions

- Lack of funding
- Lack of highly trained personnel
- Insufficient government policy support

Production

Rice Farmers

- Lack of access to machinery
- Significant post-harvest loss due to storage and processing deficiencies
- Difficulties marketing and selling their product

Farmer Associations

- Poor access to mechanization among members
- Low-quality processing and storage techniques
- Insufficient access to credit

Government Ministries and Agencies

- Lack of coordination between agencies
- Lack of sound monitoring and evaluation systems
- Not enough agents being recruited to support programs

Financial and Insurance Institutions

- Farmers lack knowledge about products offered
- Diversion of funds to other projects
- Lack of specific products for rice value chain actors

Processing

Cottage and Industrial Processors

- High cost of diesel and spare parts
- Insufficient power supply
- Lack of access to finance

Fabricators

- Importation of machines is reducing the patronage of fabricators
- Insufficient power supply
- Farmers are more used to doing this work themselves

Implementing Partners

- Lack of funds for continuing projects
- Lack of affordable extension services
- Lack of access to quality inputs and technologies to provide

Commerce

Traders

- Lack of capital to purchase rice and necessary inputs
- Low quality of produce supply
- Excessively high transportation costs and poor road infrastructure

Rice Consumers

- Local rice can be more expensive than imported rice
- Difficulties finding local rice without stones
- Prefer taste that is found in mainly in stored rice, and most local rice is not stored properly

SOURCES: ALL KIIS, DERFTDAN 2022

Figure 29: Summary of Challenges Faced by all Rice Value Chain Actors in Nigeria
Source: Derftdan Farmer Survey and KII 2022

5. Rice Value Chain in China and Top Rice Producing Countries



Key Takeaways

1. China is one of the largest and most efficient rice producing nations in the world.
2. Part of China's success is owed to post-harvest operations aided by technology to ensure rice quality.
3. Increasing agricultural mechanization subsidized by the government also plays a major role in China's high rice yields.
4. Farmer-led supply chains help mobilize household resources for access to quality products and improve the lifestyle of the average household.

China is the world's largest rice-producing and consuming nation,⁹⁷ and the first country in the world to successfully produce hybrid rice, bred from two different types of plants – *indica* and *japonica*. Around 212.84 MMT of this hybrid rice was produced in 2021.⁹⁸ Northeast China is one of the most important grain-producing regions of China, which accounts for over 20% of China's total sown rice area of more than 4 million ha. In 2021, the hectareage of rice plantations in China amounted to around 30 million ha.⁹⁹

Agricultural growth has been highly efficient, sustainable, and effective in top rice-producing countries. Agricultural growth has been proven to reduce poverty and hunger across top-producing rice countries. Bangladesh has made significant progress over the past several decades in terms of economic growth, poverty reduction, and human development. Rice yield in Bangladesh has grown considerably mainly due to increased use of high-yielding rice varieties, groundwater irrigation, chemical fertilizer, and pesticides.¹⁰⁰

The World Bank states that China's agricultural growth was three-and-a-half times more effective in poverty alleviation when compared with growth in other sectors of its economy.¹⁰¹ This is consistent with a broader global trend, as growth in agriculture is two to three times more effective at reducing poverty than equivalent growth in other sectors.¹⁰² Technology played a crucial role in China's agricultural development, especially in terms of production efficiency. China is the world's largest grain producer, and its agricultural processes are highly efficient while using minimal arable land. Although aggressive agricultural practices have contributed to widespread soil degradation, the Chinese government is currently working on solutions to boost soil health.¹⁰³

Chinese farmers use various post-harvest operations to ensure rice quality and reduce post-harvest loss. In China, the post-harvest process can be generally divided into seven stages: harvest, transport, drying, storage, processing, distribution, and consumption. Operations such as drying, storage, and milling have been particularly used to ameliorate the aging of rice grains and to maintain desirable rice grain quality, and thus play a key role in determining rice commercial quality and value.¹⁰⁴ Aging is a post-harvest storage process to improve rice quality and functional properties (flavor, color, and aroma). Stored rice is often preferable to

⁹⁹ Statista (2021). <https://www.statista.com/statistics/280168/acreage-of-rice-in-china/#:~:text=The%20statistic%20shows%20the%20acreage,to%20around%2030%20million%20hectares.>

¹⁰⁰ Rahman, M.M., Connor, J.D. The effect of high-yielding variety on rice yield, farm income and household nutrition: evidence from rural Bangladesh. *Agric & Food Secur* 11, 35 (2022). <https://doi.org/10.1186/s40066-022-00365-6>

⁹⁵ Liu, L., Ross, H., & Ariyawardana, A. (2020). Community development through supply chain responsibility: A case study of rice supply chains and connected rural communities in central China. *Sustainability*, 12(3), 927. <https://doi.org/10.3390/su12030927>

¹⁰² Christiaensen, L., & Martin, W. (2018). Five new insights on how agriculture can help reduce poverty. World Bank Blogs. Retrieved October 4, 2022, from <https://blogs.worldbank.org/jobs/five-new-insights-how-agriculture-can-help-reduce-poverty>

¹⁰³ New Security Beat (2019). Reclaiming China's Worn-out Farmland: Don't Treat Soil Like Dirt. <https://www.newsecuritybeat.org/2019/05/reclaiming-chinas-worn-out-farmland-dont-treat-soil-dirt-2/>

⁹⁶ Liu, L., Ross, H., & Ariyawardana, A. (2020). Community development through supply chain responsibility: A case study of rice supply chains and connected rural communities in central China. *Sustainability*, 12(3), 927. <https://doi.org/10.3390/su12030927>

freshly harvested rice because it has a favored taste and aroma and increases milling quality.¹⁰⁵ There are two rice aging processes – natural aging and artificial aging, respectively.¹⁰⁶

While the manufacturing of farm machinery in China has transformed traditional farming infrastructure into modern agriculture systems, it has developed a local machine manufacturing sector in Vietnam. High mechanization rates in China are attributed to the impact of science, technologies, and experiences from international and regional exchanges on agricultural mechanization and the development of the manufacturing industry. It is pertinently important to note that since 2004, the government has provided subsidies for the purchase of agricultural machinery for farmers at the provincial level. These subsidies are aimed at increasing the mechanization of rice planting.^{107,108,109} In 2020, the national crop planting and harvesting mechanization rate reached 71% and the mechanization rate of planting and harvesting exceeded 85% for rice. Even small-scale millers use small rice milling machines in China, such as separate rice milling machines, combined rice mills, and spray rice mills.¹¹⁰

Contrast China with Vietnam where secondhand tractors and combine harvesters are imported majorly from Japan and used for both personal rice cropping needs and custom hiring services for other farm households three times a year. Thus, farm machine owners in Vietnam tend to replace their machines within a short period. This has led to the boom of domestically repaired and customized machines by local workshops in rural areas.¹¹¹

Government support of farmer-led clusters helps rice farmers with reducing production costs. In India, four paddy clusters funded by the central government's scheme for Funds for Regeneration of Traditional Industries were recently approved and over 1000 farmers across North Goa will form a paddy cluster under this project. Through this initiative, the Government of India will be providing a 90% subsidy to the paddy processing units which will ensure farmers get a good price for their yield.¹¹²

As in most parts of the world, in China, there has been an upward trend in rural-urban migration. One of the consequences of increased rural-urban migration is that farmers have started to increasingly purchase many small and general-purpose machines. Farmers also started the Combine Service Enterprise (CSE) cluster which provides harvesting services in 12 provinces. This reduces the burden of high fixed costs associated with machine and equipment purchases for farmers. The initial success of the CSE is fueled by a government subsidy, which is about USD10,000 per machine, provided to help less resourceful farmers participate in the growing cluster.¹¹³

Diverse farmer-led rice supply chains are integral to China's high rice production. There are two types of rice supply chains led by farmers in China. In one type of rice chain, a single farmer manages a whole supply chain process, from the production to the processing in their mill to the marketing to other villagers and restaurants. In the other type of rice supply chain, farmer groups act as brokers to collect rice from individual farmers and supply it either to mills or to Sinograin (a state-owned enterprise located in Beijing China). Both types of

⁹⁷ Liu, L., Ross, H., & Ariyawardana, A. (2020). Community development through supply chain responsibility: A case study of rice supply chains and connected rural communities in central China. *Sustainability*, 12(3), 927. <https://doi.org/10.3390/su12030927>

⁹⁸ Liu, L., Ross, H., & Ariyawardana, A. (2020). Community development through supply chain responsibility: A case study of rice supply chains and connected rural communities in central China. *Sustainability*, 12(3), 927. <https://doi.org/10.3390/su12030927>

⁹⁹ Liu, L., Ross, H., & Ariyawardana, A. (2020). Community development through supply chain responsibility: A case study of rice supply chains and connected rural communities in central China. *Sustainability*, 12(3), 927. <https://doi.org/10.3390/su12030927>

¹⁰⁰ Liu, L., Ross, H., & Ariyawardana, A. (2020). Community development through supply chain responsibility: A case study of rice supply chains and connected rural communities in central China. *Sustainability*, 12(3), 927. <https://doi.org/10.3390/su12030927>

¹⁰¹ Liu, L., Ross, H., & Ariyawardana, A. (2020). Community development through supply chain responsibility: A case study of rice supply chains and connected rural communities in central China. *Sustainability*, 12(3), 927. <https://doi.org/10.3390/su12030927>

¹¹¹ Sakata, S. (2020). The mechanization of rice production in Vietnam: An analysis of lifecycle of agricultural machinery. *Ide.Go.Jp*. Retrieved October 4, 2022, from https://www.ide.go.jp/library/English/Publish/Reports/Brc/pdf/27_07.pdf

¹¹² Times of India (2022). <https://timesofindia.indiatimes.com/city/goa/centre-approves-2000ha-paddy-cluster-in-north-goia/articleshow/93415810.cms>

farmer-led rice supply chains play a role in mobilizing household-level resources for high-quality and low-price food products. Although the farmer-led rice supply chains have diverse economic, social, and environmental sustainability capacities, their potential is restricted due to limited access to government investments in farming facilities and funds for mill improvements.¹¹⁴ Figure 30 shows the supply chain network of farmer-led rice production in China.

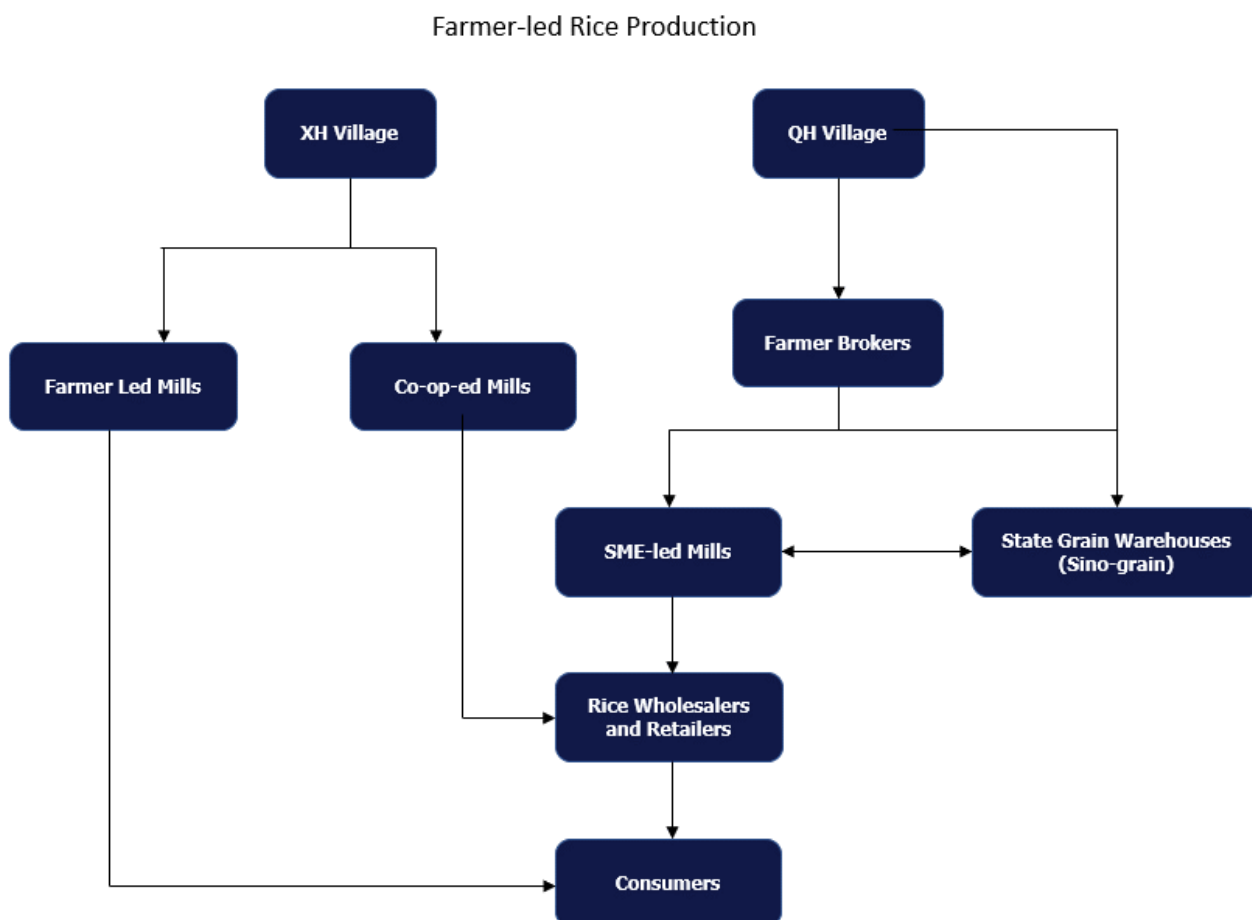


Figure 30: Farmer-led Rice Supply Chain Network in China
Source: Derftdan Desk Research, 2022

The use of machinery has a huge impact on rice yield and field harvest loss. The average rice harvest loss rate in China is 3.65% with losses decreasing as the scale increases. Several studies in China, including two field trials¹¹⁵ and one farmer survey,¹¹⁶ indicated that losses due to combined harvesting (combination of reaping, threshing, and winnowing into a single process) are higher than the total losses from segmented harvesting. Hence, combine harvesting increases harvest losses but when farmers outsource harvesting work to specialized mechanization service providers or farmers, the loss is reduced.¹¹⁷

¹¹⁴ Liu, L., Ross, H., & Ariyawardana, A. (2020). Community development through supply chain responsibility: A case study of rice supply chains and connected rural communities in central China. *Sustainability*, 12(3), 927. <https://doi.org/10.3390/su12030927>

¹¹⁵ Huang, D. Yao, L., Wu, L., Zhu, X. (2018). Measuring Rice Loss during Harvest in China: Based on Experiment and Survey in Five Provinces. *J. Nat. Resour.* 2018, 33, 1427–1438

¹¹⁶ Qu, X., Kojima, D., Nishihara, Y., Wu, L.-P., & Ando, M. (2021). Can harvest outsourcing services reduce field harvest losses of rice in China? *Journal of Integrative Agriculture*, 20(5), 1396–1406. [https://doi.org/10.1016/s2095-3119\(20\)63263-4](https://doi.org/10.1016/s2095-3119(20)63263-4)

¹¹⁷ Qu, X., Kojima, D., Nishihara, Y., Wu, L.-P., & Ando, M. (2021). Can harvest outsourcing services reduce field harvest losses of rice in China? *Journal of Integrative Agriculture*, 20(5), 1396–1406. [https://doi.org/10.1016/s2095-3119\(20\)63263-4](https://doi.org/10.1016/s2095-3119(20)63263-4)

However, the impact of machinery on losses depends on the farming scale and on which stages of the harvest machinery is used. Studies have shown that large-scale farms record smaller losses per unit area than small-scale farms owing to the use of machinery in China.¹¹⁸ A larger scale helps reduce losses, while combined harvesters increase the loss rate of middle-scale farmers and reduce that of large-scale farmers. Small and middle-scale farmers are vulnerable to production and harvesting conditions, such as pests and labor shortages whereas large-scale farmers are more affected by household and individual characteristics. A high household income increases losses while a high proportion of rice income reduces losses. For these reasons, an effective approach to loss reduction is to adopt different measures according to the farming scale.¹¹⁹

In Vietnam, despite the resources invested in developing post-harvest technologies such as mechanical drying solutions instead of over-reliance on sun-drying, high grain losses continue to be an issue.¹²⁰ Major contributing factors are hesitation by farmers/communities to accept the technology, and issues with scaling such technology.

¹¹⁸ Wu, L., Hu, Q., Wang, J., Zhu, D. (2017). Empirical Analysis of the Main Factors Influencing Rice Harvest Losses Based on Sampling Survey Data of Ten Provinces in China. *China Agric. Econ. Rev.* 2017, 9, 287–302

¹¹⁹Qu, Xue & Kojima, Daizo & Nishihara, Yukinaga & Wu, Laping & Ando, Mitsuyoshi. (2021). A Study of Rice Harvest Losses in China : Do Mechanization and Farming Scale Matter?. *Japanese Journal of Agricultural Economics.* 23. 83-88. 10.18480/jjae.23.0_83.

¹²⁰Lam N.D. (2022). Post-Harvest Research and Development in Vietnam. <https://un-csam.org/sites/default/files/2021-01/post-harvest%20Research%20and%20Development%20in%20Vietnam%20.pdf>

6. Comparative Analysis: Nigeria vs. China



Key Takeaways

1. China is more efficient than Nigeria in both yield (7.1 vs 2.5 MT/ha) and management of post-harvest losses (11.39% vs 3.65%).
2. China's efficiency is owed to its high mechanization rate of 8 hp/ha in comparison to Nigeria at 0.3 hp/ha.
3. Lack of technology and government support limits the growth of the rice market in Nigeria. Inefficient processing techniques, low mechanization rates, and non-existent government subsidy programs for agricultural technology impair the Nigerian rice market when compared to the Chinese rice market.
4. By adopting mechanization in the production and processing of rice in Nigeria, labor hours can be cut by 84% and revenue can increase by at least 17%.
5. Renting of reapers and threshers for processing rice can increase production cost per hectare by 12.6% in Nigeria.

China and Nigeria are both rice production and consumption leaders in their continent with government policies having encouraged local production in some way. In addition, both countries have a relatively large population. The two countries however differ in the level of mechanized and technological adoption in rice farming, impact of rice farming on poverty alleviation through consistently realizing efficient and sustainable growth, reduction of post-harvest losses both in terms of quality and quantity, and dedicated government support across the entire value chain.^{121,122,123,124,125,126}

The following section compares Nigeria and China across the spectrum of challenges that the Nigerian rice value chain faces.

6.1 Irrigation

Although Nigeria is Africa's largest rice producer, Nigerian rice paddies' low proportion of irrigated rice greatly hurts its output when compared to the typically irrigated Chinese paddies. The efficiency of Chinese rice production alongside its post-harvesting segments gives credence to the country as being the world's largest producer of rice.¹²⁷ Although Nigeria is Africa's largest rice producer, 69% of rice is grown in rain-fed lowlands. Only an estimated 2.7% of rice is irrigated in Nigeria, a sharp contrast from China's 99%.¹²⁸ While both countries lead production volume in their respective continents, there is a wide gap between the production yield, mechanization rate, and harvest losses between the countries. Table 1 gives an overview of rice industry statistics for China compared to Nigeria.

¹²¹ Xiao-qiang, J., Nyamdavaa, M. Fu-suo, Z. (2018). The transformation of agriculture in China: Looking back and looking forward, *Journal of Integrative Agriculture*, 17(4), 755-764, ISSN 2095-3119,

[https://doi.org/10.1016/S2095-3119\(17\)61774-X](https://doi.org/10.1016/S2095-3119(17)61774-X). (<https://www.sciencedirect.com/science/article/pii/S209531191761774X>)

¹²² World Bank (2022). <https://www.worldbank.org/en/country/china/overview#1>

¹²³ Hegazy, R., Schmidley, A. Bautista, E., Sumunistrado, D., Gummet, M. and Elepano, A. (2013). Mechanization in rice farming – lessons learned from other countries.

¹²⁴ Ministry of Agriculture and Rural Affairs, PRC (2020). 1.21 Million Rural Households Benefit from Farm Machinery Subsidies in 2020. http://english.moa.gov.cn/news_522/202008/t20200805_300516.html

¹²⁵ China Daily (2020). Subsidies to help farmers replace old agricultural machinery. <https://global.chinadaily.com.cn/a/202003/02/WS5e5cee16a31012821727bae0.html>

¹²⁶ Shi, M., Paudel, K. P., & Chen, F.-B. (2021). Mechanization and efficiency in rice production in China. *Journal of Integrative Agriculture*, 20(7), 1996–2008. [https://doi.org/10.1016/s2095-3119\(20\)63439-6](https://doi.org/10.1016/s2095-3119(20)63439-6)

¹²⁷ Global Yield Gap Atlas (n.d). <https://www.yieldgap.org/China>

¹²⁸ Infoguide (2018). <https://infoguidenigeria.com/rice-production-nigeria-2018-2019/>

Table 1: Rice Statistics of China vs. Nigeria

Statistic	China	Nigeria
Agriculture gross production value (USD million)	1,116,974	30,998
Paddy production value (USD million)	128,000	981
Production volume (milled in million tons)	148.99	5.00
Yield (MT/ha)	7.1	2.1
Mechanization rate (Hp/ha)	8	0.3
*Post-harvest losses (%)	3.65	11.39

*Estimated losses during rice post-harvest level (threshing, cleaning, paddy drying, transporting, parboiling, milling, and other postharvest processing activities)

Sources: Derftdan desk research 2022; USDA 2022; Liu, *et al*; Statista; PwC; Danbaba *et al.* 2019

6.2 Processing

Nigeria's rice post-harvest and processing techniques are largely inefficient. This has resulted in processed rice that is too expensive and of lower quality in comparison to rice from other countries like China, Vietnam, and India.¹²⁹ The inefficient harvesting and storage techniques of rice paddy by small-scale farmers affect the quality of milled rice. Due to the poor quality of locally produced rice, most consumers prefer imported rice from other countries, such as Thailand and China to indigenous rice in Nigeria.¹³⁰ The main reason for this preference for imported rice is that most Nigerian rice processors lack adequate technology to meet international standards, resulting in locally produced rice containing stones and other impurities.¹³¹

6.3 Mechanization and Government Investment

Nigeria's mechanization has remained low at 0.3 hp/ha, relative to 2.6 hp/ha in India and 8 hp/ha in China.¹³² The number of agricultural tractors is estimated at around 22,000 in Nigeria, relative to 1 million and 2.5 million in China and India, respectively. The Chinese government offers subsidies to farmers for the purchase of machinery that aid production, harvesting, and post-harvesting processes, which contributes to the development of the rice sector. In addition to the \$10,000 subsidy through the CSE mentioned in [Section 5](#), the Chinese government also subsidizes warehouses to store machines and even offers group messaging cell phone services for members who travel in a group.¹³³ However, in Nigeria, which is dominated by small-scale farmers who lack the resources to purchase machinery and technical skills, the traditional approach to post-harvesting is prevalent and this not only contributes to post-harvest loss but also consumes time with less income yield for farmers.

¹²⁹ The Conversation (2020). The quality of Nigerian home-grown rice is poor: here's why. <https://theconversation.com/the-quality-of-nigerian-home-grown-rice-is-poor-heres-why-144104>

¹³⁰ Idris, A., Rasaki, K., Hodefe, O. J., & Hakeem, B. (2013): Consumption pattern of Ofada rice among civil servants in Abeokuta Metropolis of Ogun State, Nigeria. *Journal of Biology, Agriculture and Healthcare*, 3(6), 106-112. <https://core.ac.uk/download/pdf/234658861.pdf>

¹³¹ Adisa B.O., Famakinwa M., & Adeloye K.A. (2020). Adoption of Rice Post-Harvest Technologies Among Smallholder Farmers In Osun State, Nigeria. *Serbian Journal of Agricultural Sciences*, 69(1-2), 20-26. <https://sciendo.com/downloadpdf/journals/contagri/69/1-2/article-p20.pdf>

¹³² PWC (2018). Boosting rice production through increased mechanization. <https://www.pwc.com/ng/en/publications/boosting-rice-production-through-increased-mechanisation.html>

¹³³ Yang, J., Huang, Z., Zhang, X., & Reardon, T. (2013). The rapid rise of cross-regional agricultural mechanization services in China. *American Journal of Agricultural Economics*, 95(5), 1245-1251. <https://doi.org/10.1093/ajae/aat027>

The subsidy on machinery purchase for farmers by the Chinese government demonstrates the inclusion of the government in the agricultural supply chain, especially the production and post-harvest processing of rice. As stated earlier, in Nigeria, there are policies aimed at increasing domestic agricultural production and ensuring self-sufficiency in rice and other staple crops production as part of the Agricultural Transformation Agenda Support Program-Phase 1 (ATASP-1) policy. However, they lack the corresponding effort to advance technology adoption. While improvement has been seen in the usage of hybrid seeds, not much improvement has been observed in the post-harvest segment, especially for small and medium-scale rice farmers, and cottage processors.

Business competitiveness increases as operation scales, especially through mechanization. The scale of operation often influences the production cost and return on investment, especially in Nigeria where smallholder farmers have a small portion of land and have limited access to credit facilities, quality input, and machinery. A larger farm usually corresponds to increased production costs and increased returns on investment.¹³⁴ In contrast, the business opportunity for processors is significant in China. The milling capacity in China is huge – there are more than 5,000 mills. China is also home to the world’s largest milling company: Wudeli Flour Group. This capacity gives a high business competitive factor and profitability margin in rice production against Nigeria where there are about 58 to 64 milling facilities with a limited technical supply of labor.

Another key aspect of comparison is the investment in research and development (R&D), which aided many Asian countries to establish strong monitoring and evaluation systems. China’s strong monitoring and evaluation systems, including time-series statistics on fertilizer use and irrigating areas, allowed the government to develop targeted policy initiatives to continuously improve the Chinese rice sector. Nigeria’s investments in R&D could be oriented towards improving rice seed varieties, developing novel and cost-effective irrigation schemes, and optimizing rice processing infrastructure, among other areas. Investment in R&D is essential in gaining insight into best practices that should develop the rice value chain.

6.4 Trade Regulations

The impact of trade regulations on rice production in Nigeria and China is concentrated on achieving self-sufficiency. In a bid to address the increasing gap between domestic demand and supply of rice as well as the associated foreign exchange problems, the Nigerian government introduced several policy initiatives including trade restrictions (increased tariff on imported rice and closure of land borders between 2007 and 2019). With the trade restrictions, there was an expectation that domestic rice production would expand, which would reduce local rice prices and rice importation. However, this has not yet been the outcome as prices remain high and illegal smuggling occurs. This is also largely because current local production amounts do not meet the needs of the population.

There was a significant effect of the tariff on domestic rice production between 2008 and 2019. Tariffs recorded their lowest value in 2008 at 15%. During this period, the volume of rice importation and domestic production stood at about 1.7 MMT and 4 MMT respectively. In 2019, the tariff was raised to 70%. This led to a reduction in imported rice mills of about 1.3 MMT while domestic production rose to 8.4 MMT.¹³⁵ In addition, the government views the border closure between 2019 and 2020 as a critical factor helping to lead the country towards rice self-sufficiency.¹³⁶

¹³⁴ Ewuzie, C. Ifediora, O. & Ifediora, C. & Anetoh, J. (2020). Profitability of Actors in Rice Value Chain In Nigeria: A Comparative Analysis. *International Journal of Innovative Research and Advanced Studies*, 7(7), 59-66.

https://www.researchgate.net/publication/343361174_Profitability_Of_Actors_In_Rice_Value_Chain_In_Nigeria_A_Comparative_Analysis

¹³⁵ Salik A.A and Aras O.N. (2020). Trade Restrictions and its Implications on Domestic Production of Rice in Nigeria.

<https://jb.ibsu.edu.ge/jms/index.php/jb/article/view/179/171>

¹³⁶ USDA (2022). Grain and Feed Annual.

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_NI2022-0005.pdf

Similarly, the ambition for self-sufficiency in key grains has been an important driver behind China's agricultural policies over the past two decades. These policies contributed to the liberalization of international trade and trade restrictions since the early 1990s, allowing private traders to play a role in agricultural commodity markets. The most recent editions of China's annual policy guidelines on agriculture and rural development, known as "Policy Document No.1" stresses the importance of developing a competitive and sustainable agricultural sector and of continuing supply-side reforms, while reiterating the importance of guaranteeing the necessary grains production for food security purposes (wheat and rice). There are also policy efforts to adjust the market price support system and respond to agricultural productivity and sustainability challenges.¹³⁷ Market price support is the main channel for providing support to Chinese farmers for increased production. It is provided through both domestic policies – such as the minimum purchase prices for rice and wheat – and trade policies, including tariffs, tariff-rate quotas, and state trading.¹³⁸ Like the Nigerian policies, these policies are geared towards increased rice production for self-sufficiency.

There is a significant impact of trade regulations on the price of rice in both countries. China's trade regulation on the market support price system has helped maintain stable domestic rice prices.¹³⁹ The price regulation is aimed at reducing the cost of living, maintaining the stability of consumer goods prices, and safeguarding the security and pricing of China's rice imports. Strategies that improved China's rice price control policy include building an efficient rice distribution system, improving the rice supply chain system as a whole, and improving the government's ability to regulate the price of rice.¹⁴⁰ In Nigeria, the price of processed rice is inevitably increased due to the devaluation of the Naira against the dollar which ultimately affects the importation of quality input, tariffs on rice importation, possible bans on the importation of rice, and the illegal distribution of rice across borders. The rice import tariffs average 70%, despite price controls.^{141,142}

6.5 Rice Seed Varieties

China is the first country in the world to successfully produce hybrid rice, bred from two different types of plants – *indica* and *japonica*.¹⁴³ **China's Ministry of Agriculture and Rural Affairs reported that improved rice varieties contributed more than 45% to the increase in grain production in China.** *Indica* and *japonica* are the two subspecies of cultivated rice. *Indica* rice is known to be adapted to tropical regions, while *japonica* rice is grown in temperate regions. Therefore, *indica* and *japonica* have different characteristics. In general, *japonica* varieties are known to have relatively low yield potentials, as compared to *indica* varieties. To improve the yield potential of *japonica* rice, inter-subspecific crosses between *indica* and *japonica* have been conducted by conventional rice breeders. As a result of these efforts, several high-yielding varieties have been developed from *indica-japonica* crosses.¹⁴⁴ Hybrid rice has been successfully used for commercial rice production for over 40 years in China.¹⁴⁵ Another mega rice hybrid derived from the parents Zhenshan 97A and Minghui 63 is Shanyou 63. Shanyou 63 is also a milestone for China's hybrid rice development and production because of its high yield and wide adaptability.¹⁴⁶

¹³⁷ OECD (2021). Agricultural Policy Monitoring and Evaluation 2021: Addressing the Challenges Facing Food Systems.

<https://www.oecd-ilibrary.org/sites/eedc7e5b-en/index.html?itemId=/content/component/eedc7e5b-en#section-d1e37641>

¹³⁸ OECD (2020). Agricultural Policy Monitoring and Evaluation. <https://www.oecd-ilibrary.org/sites/049d4bd3-en/index.html?itemId=/content/component/049d4bd3-en>

¹³⁹ USDA (2022). Rice Outlook.

https://downloads.usda.library.cornell.edu/usda-esmis/files/dn39x152w/cn69n798n/vx022k898/05_2022_MAY_RICE_OUTLOOK_REPORT_FINAL.pdf

¹⁴⁰ Songpo, Z. (2017). Rice Price Regulatory Policies in China Under the New Normal. Pp 85-87.

http://china.oriprobe.com/articles/52654374/Rice_Price_Regulatory_Policies_in_China_Under_the_.htm

¹⁴¹ The Guardian (2022). Rice pyramids and Nigeria's production puzzle. <https://guardian.ng/features/rice-pyramids-and-nigerias-production-puzzle/>

¹⁴² Berkeley Political Review (2022). <https://bpr.berkeley.edu/2020/11/15/on-thin-rice-analyzing-trade-policy-in-nigeria/>

¹⁴³ USDA and GAIN (2020). New to China Market Product Report – Rice.

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=New%20to%20China%20Market%20Product%20Report%20-%20Rice_Guangzhou%20ATO_China%20-%20Peoples%20Republic%20of_06-05-2020

¹⁴⁴Xie, F., Zhang, J. Shanyou 63: an elite mega rice hybrid in China. *Rice* 11, 17 (2018). <https://doi.org/10.1186/s12284-018-0210-9>

¹⁴⁵Xie, F., Zhang, J. Shanyou 63: an elite mega rice hybrid in China. *Rice* 11, 17 (2018). <https://doi.org/10.1186/s12284-018-0210-9>

¹⁴⁶Xie, F., Zhang, J. Shanyou 63: an elite mega rice hybrid in China. *Rice* 11, 17 (2018). <https://doi.org/10.1186/s12284-018-0210-9>

Although rice varieties are improving, Nigerian farmers are heavily dependent on only a few rice seeds. Improved seed varieties in Nigeria include GAWAL R1 and FARO. GAWAL R1 is a high-yielding improved variety with tolerance to blast disease and is grown in lowland rainfed and irrigated agro-ecological zones.¹⁴⁷ FARO 44 is also one of the popular rice varieties in Nigeria. 80% of rice farmers surveyed planted only FARO 44.¹⁴⁸ All 11 of the seed companies interviewed specified FARO 44 as their top seller.¹⁴⁹ It is well known for its high yielding and good milling quality. It is long grain and guarantees optimum production under low management and can produce seven tons of rice per hectare.¹⁵⁰ However, even with improved rice varieties, factors such as reliance on rain-fed cultivation of rice and weak agronomic practices have limited Nigeria's production.

Seed innovation, especially crop variety approval standards, has played a role in ensuring sustainable rice production in China. Varied approval standards are conducive to promoting the selection of rice varieties and guiding the direction of rice variety trait improvement.¹⁵¹ Nigeria can improve its guidelines for the registration and release of new crop varieties and improve the rice subsidy policy. This will encourage smallholder farmers to adopt new varieties. It will also increase their willingness to grow grain, convert the potential productivity of new varieties into actual productivity, and ensure the increase and stability of rice production in Nigeria. There is a need to focus on improving both seed quality and varietal development in Nigeria. The government needs to develop improved rice varieties through intensified domestic plant breeding for its seed certification and seed subsidy programs to be more effective. Comparing past rice varietal development efforts suggests that released rice varieties in Nigeria did not perform well as those released in other countries (Table 2). This might be partly due to the limited government support for rice breeding by national programs. 8 out of 11 seed companies interviewed indicated that they had received no external support from seed projects.¹⁵²

Table 2: Rice Variety Analysis: Comparing Key (Hybrid) Rice Varieties in China and Nigeria

Rice Seed Varieties	Characteristics		
	Potential yield (MT/ha)	Grain type/ length	Typical habitat
China			
Japonica/indica hybrid rice (JIHR)	12	Not available	Not available
Shanyou 63 (SY63)	7	Not available	Widely adaptable
Indica	Not available	Long grain	South China (Tropical)
Japonica	4.5	Medium and short grain	North China (Temperate)
Nigeria			
GAWAL R1	10	Long grain	Irrigated lowland
ITA 212	8	Medium grain	Derived Savanna, Humid Forest
FARO 44	7	Long grain	Irrigated lowland
FARO 52	6	Long grain	Irrigated lowland

Sources: International Institute of Tropical Agriculture (2020)¹⁵³; Xie and Zhang Rice (2018)¹⁵⁴ and Xu, Dong & Zhu, *et al.* (2020)¹⁵⁵

6.6 Segmentation of Input expenses (Economics of Production)

Chinese rice farmers spend about four times more on inputs than Nigerian farmers (Figure 31). The national average of seed expenses incurred by smallholder farmers in Nigeria is USD 33.6 per ha compared

¹⁴⁷ Syngenta and Sahel Consulting (2021). Reorienting public agriculture R&D for achieving sustainable, nutritious and climate resilient food systems in Nigeria. https://www.syngentafoundation.org/sites/g/files/zhg576/f/2021/11/25/reorienting_agri_rd_for_sustainability_in_nigeria_final.pdf

¹⁴⁸ Derftdan Farmer Survey (2022)

¹⁴⁹ Rice Stakeholders KII, Derftdan (2022)

¹⁵⁰ Afrimash (n.d). [https://www.afrimash.com/shop/afrimash-crop-section/faro-44-rice-paddy-per-kg/#:~:text=Faro%2044%20\(also%20known%20as,than%20five%20tonnes%20per%20hectare](https://www.afrimash.com/shop/afrimash-crop-section/faro-44-rice-paddy-per-kg/#:~:text=Faro%2044%20(also%20known%20as,than%20five%20tonnes%20per%20hectare)

¹⁵¹ Zhao, Y., Deng, H., Hu, R., & Xiong, C. (2022). Impact of Government Policies on Seed Innovation in China. *Agronomy*, 12(4), 917. <https://www.mdpi.com/2073-4395/12/4/917>

¹⁵² Derftdan Rice KII, 2022

¹⁵³ Nigerian Seed Portal Initiative, Kamai, N., Omoigui, L. O., Kamara, A. Y. and Ekeleme, F. (2020). Guide to Rice Production in Northern Nigeria. International Institute of Tropical Agriculture, Ibadan, Nigeria

¹⁵⁴ Fangming Xie and Jianfu Zhnag (2018). Shanyou 63: an elite mega rice hybrid in China. <https://doi.org/10.1186/s12284-018-0210-9>

¹⁵⁵ Xu, D. and Zhu, *et al.* 2020. Yield characteristics of japonica/indica hybrids rice in the middle and lower reaches of the Yangtze River in China. *Journal of Integrative Agriculture*, 19, 2394-2406. 10.1016/S2095-3119(19)62872-8.

with Chinese farmers at USD 138.2 per ha.^{156,157} This disparity is due to the high usage of hybrid seeds in China which is more expensive than conventional seeds. Similarly, compared with Chinese rice farmers that spend about USD 95.4 per ha on chemical fertilizers, Nigerian rice farmers spend USD 21.9 per ha.¹⁵⁸ While China's chemical fertilizer usage (340.8 kg/ha) is above the internationally recognized maximum safe usage (225 kg/ha), Nigeria's usage is 11.5 times below the international average (19.6 kg/ha).^{159,160} Zooming in on Nigeria, states such as Cross river, Niger, Ebonyi, and Jigawa spend only small amounts of money on inputs including crop protection products such as pesticides and herbicides (Figure 32).

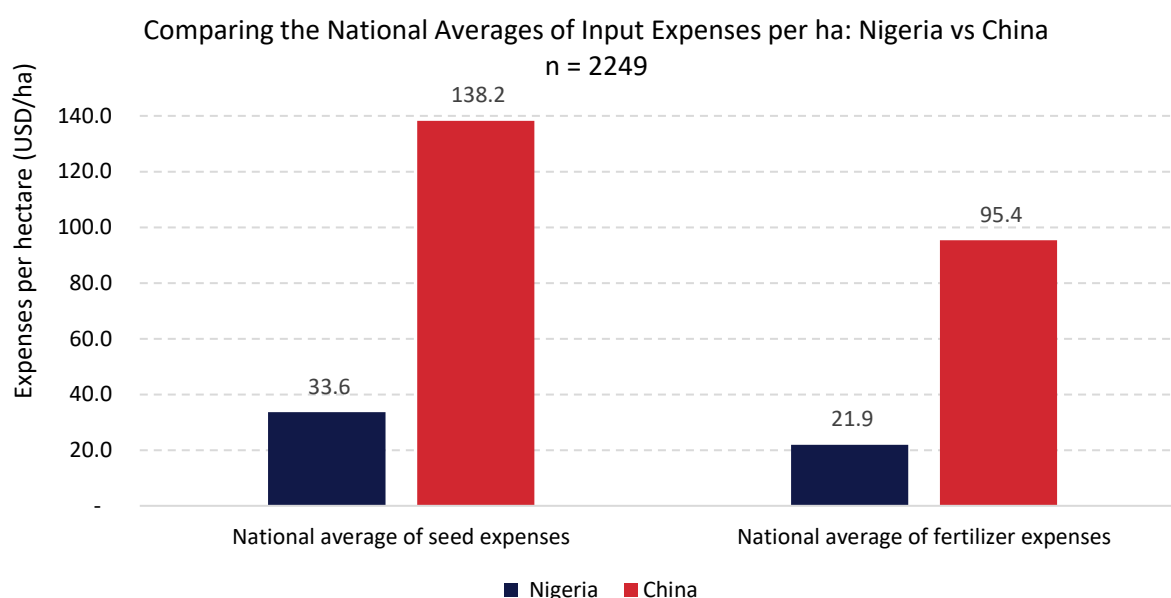


Figure 31: Comparing the National Averages of Input Expenses per ha: Nigeria vs China

Sources: Baffes, J., & Koh, W. C. (2021). Mcgrath, C., & Branson, A. (2021). IRRI (2012). Sun, Z., & Li, X. (2021).

¹⁵⁶ Mcgrath, C., & Branson, A. (2021). Seed industry development a high priority of top Chinese leadership. USDA. https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Seed%20Industry%20Development%20a%20High%20Priority%20of%20Top%20Chinese%20Leadership_Beijing_China%20-%20People%27s%20Republic%20of%2006-08-2021#:~:text=According%20to%20MARA%20data%2C%20the,14%2C521%20ha%20is%20late%20rice.

¹⁵⁷ IRRI (2012). Q&A with the father of hybrid rice. <https://ricetoday.irri.org/qa-with-the-father-of-hybrid-rice/>

¹⁵⁸ Baffes, J., & Koh, W. C. (2021). Fertilizer prices expected to stay high over the remainder of 2021. World Bank Blogs. <https://blogs.worldbank.org/opendata/fertilizer-prices-expected-stay-high-over-remainder-2021>

¹⁵⁹ Worldbank (n.d.). <https://data.worldbank.org/indicator/AG.CON.FERT.ZS?locations=NG>

¹⁶⁰ Sun, Z., & Li, X. (2021). Technical efficiency of chemical fertilizer use and its influencing factors in China's rice production. *Sustainability*, 13(3), 1155. <https://doi.org/10.3390/su13031155>

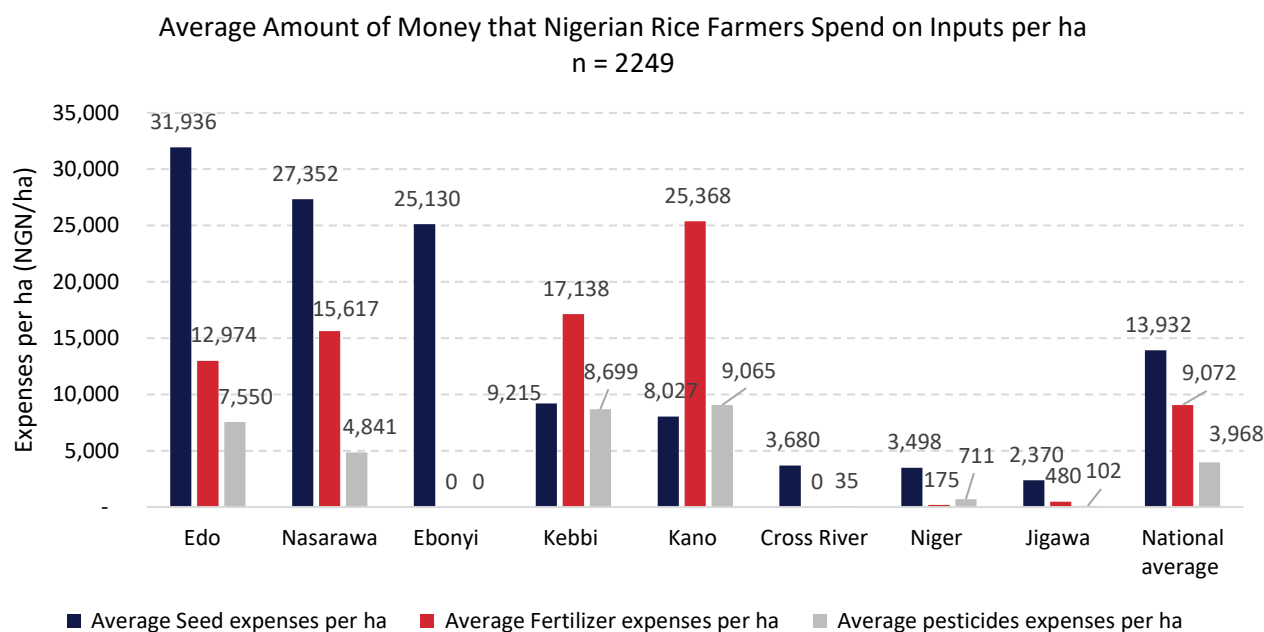


Figure 32: Average Amount of Money that Nigerian Rice Farmers Spend on Inputs per ha
Source: Derftdan Farmer Survey and KII 2022

6.7 Characteristics of the Post-harvest and Processing Segments

Excluding government initiatives that ensure rice value chain actors have enough disposable income, the post-harvest and processing segments of China and Nigeria have widely different characteristics. For example, Chinese farmers ameliorate the aging of rice by drying, storing, and milling to ensure rice quality, improve functional properties (flavor, color, and aroma), and reduce post-harvest loss.¹⁶¹ Stored rice is preferred to freshly harvested rice because of its favored taste, aroma and increased milling quality.¹⁶²

Table 3 compares the various factors that determine the rice output of Nigeria and China.

Table 3. Rice Post-Harvest / Processing Characteristics Analysis: Nigeria vs China

Characteristics of Post-Harvest / Processing Segment	China	Nigeria
1. Technology	As of 2019, farm mechanization exceeds 70% (8 hp/HA). The development of agricultural science and technology has significantly improved China's ability to transition to modern agriculture systems. In addition, the use of advanced technology such as sensors to monitor local temperature in granaries has improved the insecticidal rate and reduced the cost of inputs.	Mechanization rate is low in Nigeria at an estimated 7% (0.3 hp/HA). National rice milling capacity is 3 MMT from over 68 integrated mills across the country. ¹⁶³ However, the high cost of power for milling operation remains a major challenge. ¹⁶⁴
2. Players	Smallholder farmers living in rural provinces play a huge role in China's rice output while the state-owned company, Sinograin plays an active role in ensuring food security. ¹⁶⁵	Equitable distribution of costs and benefits is hard to establish among rice market actors in Nigeria. Rice farmers have the least net return (income) in the value chain partly due to their small scale of operations.

¹⁶¹ Chuan Tong, Haiyan Gao, Shunjing Luo, Lie Liu, Jinsong Bao (2019). Impact of Postharvest Operations on Rice Grain Quality: A Review. <https://pubmed.ncbi.nlm.nih.gov/33336927/>

¹⁶² Saikrishna, A., Dutta, S., Subramanian, V., Moses, J. A., & Anandharamakrishnan, C. (2018). Ageing of rice: a review. *Journal of Cereal Science*, 81, 161-170. <https://www.sciencedirect.com/science/article/abs/pii/S0733521018301942>

¹⁶³ Naija 247 News. 2022. <https://naija247news.com/2022/03/01/nigerias-domestic-rice-milling-capacity-hits-3m-metric-tonnes-from-68-integrated-mills/>

¹⁶⁴ The Guardian (2022). Rice pyramids and Nigeria's production puzzle. <https://guardian.ng/features/rice-pyramids-and-nigerias-production-puzzle/>

¹⁶⁵ World Grain (2020). <https://www.world-grain.com/articles/13745-china-grain-industry-rebounding>

Characteristics of Post-Harvest / Processing Segment	China	Nigeria
		Processors and traders have a significantly higher net return and lower benefit-cost ratio. ¹⁶⁶
3. Storage	The national grain storage capacity was reported to be more than 650 million tons in 2021. The country plans to increase its grain stockpiling program with 10.85 million tons of additional storage capacity. ¹⁶⁷	The national grain storage capacity is currently about 300,000 tons but is expected to reach 800,000 tons when all silo complexes under construction are operational. ¹⁶⁸ The various grain reserves established in the country have not been functioning efficiently due to poor design and management. ¹⁶⁹ In 2014, the government initiated a public-private partnership (PPP) program to concession the existing 33 grain silo complexes across the country.
4. Subsidy	The central government provides grain farmers with a variety of agricultural subsidies to support summer rice harvest (and autumn sowing production). ¹⁷⁰	The CBN Anchor Borrowers' Program (ABP) improved the production capacity of rice farmers across the country and attracted more youths to the rice value chain. ¹⁷¹
5. Policy	Major rice and wheat producing areas have access to the Minimum Purchase Price Policy which ensures rice farmers sell their paddies at a competitive price to the government when the market price drops.	The Rice Assured Advocacy Forum (RAAF), an initiative under the Rice Policy Advocacy Initiative of Nigeria (RIPAIN), aims to harmonize the national rice value chain actors in Nigeria to advocate for better policies towards the development of the rice sector. ¹⁷²
6. Standards	There is a well-documented national standard for processing rice that describes the quality requirement for different grades of rice. In 2018, China's State Administration for Market Regulation (SAMR) updated the 2009 national standard for rice. The new national standard applies to both domestically produced and imported rice, narrowing grading specifications for each class of rice. ¹⁷³ In addition, the method of estimating post-harvest loss is different than most countries'. Losses are often estimated as a percentage of the amount remaining from the previous stage of postharvest operation. ¹⁷⁴	While the Standards Organization of Nigeria (SON) had standards for brown, white and parboiled rice since 1997, specific grading standards have not been established. This is considered to have a negative effect on establishing a price structure in line with rice quality. ¹⁷⁵

¹⁶⁶ Ewuzie, C. and Ifediora, O. Ifediora, C. and Anetoh, J.. (2020). Profitability of Actors in Rice Value Chain In Nigeria: A Comparative Analysis. https://www.researchgate.net/publication/343361174_Profitability_Of_Actors_In_Rice_Value_Chain_In_Nigeria_A_Comparative_Analysis

¹⁶⁷ WORLD-GRAIN.com (2021). China to increase grain storage capacity. <https://www.world-grain.com/articles/15538-china-to-increase-grain-storage-capacity>

¹⁶⁸ FMARD (2016). PPP Transaction For 33 Silo Complexes In Nigeria. <https://ppp.icrc.gov.ng/media/384>

¹⁶⁹ Ndukwu, C., Akani, O. A. and Simonyan, K. (2015). Nigeria's grain resource structure and government sustainable policy: A review. *Agricultural Engineering International: The CIGR e-journal*. 17. 441-457. <https://cigrjournal.org/index.php/Ejournal/article/view/3019>

¹⁷⁰ Xinhua News Agency (2022). <https://www.tellerreport.com/news/2022-06-08-in-the-past-ten-years-of-china--stabilize-the-%22rice-bowl%22-and-keep-the-bottom-line-china-guarantees-food-security.rjSggavpu9.html>

¹⁷¹ Olanrewaju, O. Osabohien, R. & Fasakin, I.(2020). The Anchor Borrowers Programme and youth rice farmers in Northern Nigeria. *Agricultural Finance Review*. <https://www.emerald.com/insight/content/doi/10.1108/AFR-03-2020-0039/full/html>

¹⁷² RIPAIN. <https://ripain.org/about/>

¹⁷³ USDA Foreign Agricultural Service. GAIN Report. 2019.

[https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=National%20Standard%20for%20Rice%20\(GB-T%201354-2018\)_Beijing_China%20-%20Peoples%20Republic%20of_3-28-2019.pdf](https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=National%20Standard%20for%20Rice%20(GB-T%201354-2018)_Beijing_China%20-%20Peoples%20Republic%20of_3-28-2019.pdf)

¹⁷⁴ Sadiya, S. Hassan, S. (2018). Postharvest Loss in Rice: Causes, Stages, Estimates and Policy Implications. *Agri Res & Tech: Open Access J.* 2018; 15(4): 555964. DOI: 10.19080/ARTOAJ.2018.15.555964.

¹⁷⁵ Coalition for African Rice Development

(CARD). National Rice Development Strategy (NRDS) for the Federal Republic of Nigeria. 2009. https://riceforafrica.net/wp-content/uploads/2021/09/nigeria_en.pdf

6.8 Key Learnings for Nigeria



5 Key Lessons Highlighted

What Nigeria can learn from China's rice post-harvest and processing:

1. Invest in rice research and development, especially in terms of seed and equipment.
2. Establish strong monitoring and evaluation systems (e.g., time-series statistics on irrigated areas, number of tractors, fertilizer use) to inform future policies.
3. Promote purchases of many small and general-purpose machines for shared, cluster use; ignite usage through subsidies.
4. Continue strong import protection policies.
5. Intervene in the market to help organize and facilitate market flow, especially in terms of transport, machinery, and industry best practices.

Agriculture growth in Nigeria has increased in recent years, yet there is much to learn from China's agricultural success to increase outputs and resolve persisting food security challenges. China has demonstrated sustainable growth in agriculture, improvement in the livelihood of small-scale farmers, and success in reducing rural poverty.

Nigeria can learn from China on the use of technological advances and policy support from the government.

China's grain yield increased from 1 MT/ha in 1961 to 7.1 MT/ha in 2021 through the support of modern technology and distinct governmental policy.¹⁷⁶ Asia's Green Revolution decades ago relied heavily on protective policies against imports and strong state involvement in providing subsidies and intervening in the market to help coordinate access to input and output markets and stabilize prices.¹⁷⁷

Their efforts were effective because they invested heavily in rice research and development, irrigation, and physical infrastructure. China has strong monitoring and evaluation systems including adequate time-series statistics on irrigated areas, the number of tractors, fertilizer use, etc. which proved crucial in evaluating future policy options and progress monitoring. The policy and investment framework for transforming Nigeria's rice economy is promising if it can be successfully implemented, kept consistent, and on course.

Government investments into rice R&D in Asian and Latin American countries (namely Brazil, Peru, and Uruguay) have increased the popularity of domestically bred rice varieties with producers. Additionally, earlier private investments in irrigation facilitated the successful adoption of high-yield varieties. Governments also invested heavily in public irrigation schemes at a much higher intensity than Nigeria (given the size of arable land compared to Nigeria's). This ultimately affects a whole range of rice-sector activities, including the efficiency of both input and output markets or the capacity of R&D and extension delivery.

Nigeria must increase funding for R&D. Successful varieties have often triggered productivity growth. Given the experiences of Latin America and Asia, Nigeria will need to increase its research and development (R&D) spending on rice if it is to boost domestic rice production in the future. In many Asian countries, the rice R&D

¹⁷⁶ Xiao-qiang, J., Nyamdavaa, M. & Fu-suo, Z. (2018). The transformation of agriculture in China: Looking back and looking forward. *Journal of Integrative Agriculture*, 17, (4), 755-764, [https://doi.org/10.1016/S2095-3119\(17\)61774-X](https://doi.org/10.1016/S2095-3119(17)61774-X).

¹⁷⁷ Johnson, M., Hazell, P. & Gulati, A. (2003). The Role of Intermediate Factor Markets in Asia's Green Revolution: Lessons for Africa? *American journal of Agricultural Economics*, 85(5), 1211-1216. <https://www.sciencedirect.com/science/article/pii/S2095311920634396>

system was decentralized, which is important for crops like rice whose production environment is diverse.^{178,179,180}

Increase mechanization rate. To achieve increased yield and economic output across the rice value chain in Nigeria, farmers need to own their machinery or have a system that enables them to hire from others. It is widely believed that in the past two decades, mechanization has been the most important reason for the steady growth of agricultural production in China despite small farm sizes, high land fragmentation, and wage increase.¹⁸¹ Nigeria can also greatly benefit from this as an increase in the mechanization rate in Nigeria from 0.3hp/ha to 0.8hp/ha in the next five years can double rice production to 7.2 MT, raise yields, and increase labor productivity. Furthermore, this can reduce post-harvest losses, increase the income generated by farmers, and deepen import substitution.¹⁸²

As with India, Nigeria's rice industry is dominated by smallholder farmers accounting for up to 80% of land holdings with an average farm size of 1.33 ha.¹⁸³ However, India was able to transition from manual farm operations to mechanized operations with rice yields doubling to 4MT/ha and rice production increasing by over 80% in the last 3 decades. This was achieved through the implementation of custom hiring among smallholder farmers which facilitated timely sowing operations with the availability of direct seeders, efficient and timely harvesting operations using threshers, improvement of grain quality using grain cleaners and higher farm produce prices.

Provide government input subsidies for rice farmers. For harvesting, post-harvesting, and processing operations, certain types of machinery subsidized by the government will be of great benefit to Nigerian farmers. Examples of these machines include mechanical harvesters, reapers, mechanical threshers/cleaners, mechanical paddy driers, parboilers, milling separators, whiteners, separators, and polishers. Since 2004, the Chinese government has provided subsidies for the purchase of agricultural machinery, and farmers commonly do not purchase machinery that is not on the subsidy list. The program is implemented at the provincial level, and it is up to local governments to decide on the machinery and models eligible for the subsidy.¹⁸⁴ As mentioned earlier, clusters, like the CSE can help with the burden of high fixed costs associated with machine and equipment purchases for farmers. These clusters must be subsidized, as much of the initial success of the CSE was fueled by a government subsidy.¹⁸⁵ The Nigerian government can learn from this and support private stakeholders, and farmers across the rice value chain.

¹⁷⁸ Zhang, X. B., Yang, J. & Wang, S. L. (2011). China has reached the Lewis turning point. *China Economic Review*, 22(4), 542–554. <https://www.sciencedirect.com/science/article/abs/pii/S1043951X11000587>

¹⁷⁹ Mbah, E. N., Ezeano, C. I., & Agada, M. O. (2016). Effects of rural-urban youth migration on farm families in Benue state, Nigeria. *International Journal of Agricultural Research, Innovation and Technology*, 6(1), 14–20. <https://www.banglajol.info/index.php/IJARIT/article/view/29207>

¹⁸⁰ Yang, J., Huang, Z., Zhang, X., & Reardon, T. (2013). The rapid rise of cross-regional agricultural mechanization services in China. *American Journal of Agricultural Economics*, 95(5), 1245–1251. <https://www.ijstor.org/stable/24476906>

¹⁸¹ Abay, K. A., Abate, G. T., Barrett, C. B., & Bernard, T. (2019). Correlated non-classical measurement errors, 'Second best' policy inference, and the inverse size-productivity relationship in agriculture. *Journal of Development Economics*, 139, 171–184. <https://www.sciencedirect.com/science/article/abs/pii/S030438781831263X>

¹⁸² PWC (n.d.). Boosting rice production through increased mechanization. <https://www.pwc.com/ng/en/publications/boosting-rice-production-through-increased-mechanisation.html>

¹⁸³ Hegazy, R., Schmidley, A., Bautista, E., Sumunistrado, D., Gummert, M., & Elepaño, A. (2013). Mechanization in Rice Farming—Lessons Learned from Other Countries. Asia Rice Foundation (ARF) publication. https://www.researchgate.net/publication/258951878_Mechanization_in_rice_farming_lessons_learned_from_other_countries

¹⁸⁴ Gummert, M., Hegazy, R., Douthwaite, B., Schmidley, A., Bautista, E., Sumunistrado, D. and Elepaño, A. (2013). Mechanization in rice farming: lessons learned from other countries. Asia Rice Foundation Forum -Mechanization in Rice Farming: Status, Challenges. Bureau of Soils and Water Management Auditorium, Quezon City. 1–80. https://www.researchgate.net/publication/258951878_Mechanization_in_rice_farming_lessons_learned_from_other_countries

¹⁸⁵ Min, S. H. I., Paudel, K. P., & Chen, F. B. (2021). Mechanization and efficiency in rice production in China. *Journal of Integrative Agriculture*, 20(7), 1996–2008. <https://www.sciencedirect.com/science/article/pii/S2095311920634396>

7. Opportunities in the Nigerian Rice Value Chain



Key Takeaways

1. Availability and accessibility of regulated quality input, and technical and financial support for farmers will ensure high and quality production of rice.
2. To attain high-quality productivity by leveraging opportunities, value chain actors and stakeholders including the government should work towards mitigating key challenges.
3. There are investment priorities and opportunities in every production and post-harvesting process to upscale rice productivity.
4. There should be a product pipeline for replenishing old and low-performing rice breeds in Nigeria. One of the gaps in the rice value chain is the lack of enough high genetic rice breeds into the market as many of the existing breeds are old and may be experiencing genetic erosion

With a conservative per capita consumption of 34 kg/year in Nigeria and a population of about 211 million, the annual market value for rice in the consumer market is USD 614.4 million at a price of USD 0.86 per kg and 10% potential.^{186,187} This presents a huge opportunity for investment in the rice sector. The quality of production, harvesting and post-harvesting processes of rice in Nigeria is dependent on mitigating the gaps that exist in the rice value chain. Use of seed and agrochemical, farm size, availability and cost of labor and capital input are significant gaps in the production frontier.¹⁸⁸ These gaps are key factors that affect all processes from the point of input supply and production to marketing, distribution, and consumption of rice in the value chain.

Figure 33 Figure 33 shows a summary of key opportunities across the rice value chain and the sections after it further elaborates on the current situation in Nigeria in these key areas, the gaps, strategies to mitigate and opportunities for the sector.

¹⁸⁶ World bank (2021). Population, total – Nigeria. <https://data.worldbank.org/indicator/SP.POP.TOTL?locations=NG>

¹⁸⁷ KPMG 2019. Rice Industry Review. <https://assets.kpmg/content/dam/kpmg/ng/pdf/audit/rice-industry-review.pdf>

¹⁸⁸ Obianefo, C. A., Nwigwe, C. A., Meludu, T. N., & Anyasie, I. C. (2020). Technical efficiency of rice farmers in Anambra State value chain development programme. *Journal of Development and Agricultural Economics*, 12(2), 67-74. <https://academicjournals.org/journal/JDAE/article-full-text-pdf/2A28CFF63551>

Summary of Key Opportunities for the Public and Private Sector in the Nigerian Rice Value Chain



Seed Systems

PUBLIC

- Pass regulations on plant variety protection and variety release process to standardize seed quality.
- Improve seed certification programs of seed companies
- Increase regional collaborations for seed development via improved seed research by leveraging funding from development organization.
- Strengthen public and private extension mechanisms for seed dissemination by linking seed companies to the Farmers Hub platform via Network managers.

PRIVATE

- The investment demand for the propagation and distribution of seeds and planting material is around USD 10.3 million annually.
- At least, 3,489 additional formal seed businesses are required to meet the demand for quality seeds in Nigeria.
- Explore input finance programs that can leverage entities such as micro-finance banks that have pre-existing relationships with farmers for seed financing.



Irrigation and Water Control Investment

PUBLIC

- Address the high cost of labor, inputs, and irrigation equipment by promoting local fabrication and repair.
- Increase knowledge and awareness on irrigation farming techniques.
- Build more water bodies across rice production areas to increase irrigation and bring about resilience
- Invest in low cost technologies for irrigation

PRIVATE

- The total investment demand for irrigation infrastructure presents a market opportunity of USD 180 million.
- Similar to a tractor-hire model, an irrigation equipment hire model can potentially serve the market



Access to Equipment and Maintenance

PUBLIC

- Create programs to improve skills necessary to provide maintenance services, as there is high demand for maintenance service
- Upgrade the existing equipment of service providers to at least meet regional standards
- Establish Farmer's service centers which are needed to bring inputs and tools closer to farmers
- Address credit facility limitations to increase the adoption of agricultural technology and equipment.

PRIVATE

- The market size is estimated at USD 9.5 million
- Situating milling operations in special economic zones can attract investors and give them confidence that their investment is safe



Marketing

PUBLIC

- Marketing and pricing is dependent on quality thus, improve milling quality by setting specific grading standards.
- Regularly update the quality requirement for different grades of rice to ensure millers keep innovating on product quality

PRIVATE

- The annual market opportunity in trading rice is estimated at USD 614.4 million
- Position the rice value chain for private investment through targeted marketing endeavors. For example, African Food Changemakers (formerly Nourishing Africa) is changing the narrative of African delicacies through targeted campaigns that showcase their value and richness.



Access to Quality Inputs

PUBLIC

- Address supply chain deficiencies via improved distributor relationship (e.g., importer to local agrochemical dealer)
- Enhance the availability of distributor working capital to meet demand at peak periods by aggregating various delivery options and consolidating the market.

PRIVATE

- Nigeria's yield per ha has not kept up with global increases. Similarly, investments (Procurement and Subsidy) in Nigeria's fertilizer industry have had no correlation with changes in yield. This is a key gap to bridge with investment into the local manufacturing of fertilizer
- Further, introduce index crop insurance to address climate change effects such as drought and flooding. E.g., PULA microinsurance

Figure 33: Summary of Key Opportunities for the Public and Private Sector in the Nigerian Rice Value Chain

Source: Derftdan Farmer Survey, 2022; Derftdan Desk Research 2022

7.1 Investment Climate in Nigeria

Nigeria, with a change in World Bank Doing Business (DB) score of 3.5, was among the top 10 economies whose ease of doing business increased the most in 2018/2019, which shows a positive outlook for the agribusiness sector. This occurred after Nigeria made regulatory changes that created a business-friendly environment.¹⁸⁹ Thus, this creates an opportunity for the growth of agribusiness. Specific examples of regulatory reform relate to the implementation of policies such as the Agricultural Promotion Policy (APP) and the recent National Agricultural Technology and Innovation Policy (NATIP). The NATIP favours agribusiness development by promoting climate-smart agriculture, rural infrastructure, export standardization, data and information management, quality agricultural inputs access and women and youth in agriculture.¹⁹⁰ The ban of several agricultural commodities such as the importation of rice and maize by the Federal Government was made to support local production and consumption.¹⁹¹ Similarly, the Federal government recently announced plans to develop 10 large-scale integrated rice mills as part of efforts to boost food production in the country. The government believes that 60 integrated large scale rice processing plants are required and must be fully operational for Nigeria to be self-sufficient in rice production¹⁹². As part of government’s investment efforts, a 32-metric tons per hour Rice was recently completed by the Lagos State Government in Imota area of Ikorodu. The rice mill which is the largest in Africa and the third largest in the world is expected to commence operations in December 2022.¹⁹³ Table 4 provides a holistic view of the investment climate in Nigeria based on World Bank Doing Business Indicators.

Table 4: Doing Business Indicators

Indicators	Description
Starting a business	To provide an enabling environment for establishing agribusiness firms, Nigeria has made it easier by reducing the time needed to register a company through the development of online platforms like a one-stop shop. Furthermore, the procedure requiring on-site inspections of business premises registration is no longer a prerequisite for business registration. ¹⁹⁴ The registration of agribusiness is important as stipulated by the Companies and Allied Matters Act, 2019. The Act led to the establishment of the Corporate Affairs Commission, a regulatory agency that also oversees the registration and regulation of agribusiness entities in Nigeria. Registration of agribusinesses is important as access to certain government incentives (e.g., tax holidays) in the agricultural sector is contingent on this registration.
Getting electricity	Despite Nigeria’s efforts to make access to power easier by enabling qualified engineers to verify new connections, 85 million Nigerians do not have access to grid electricity. Nigeria’s ease of getting electricity ranks 171 out of 190 countries. Access to electricity is considered as one of the obstacles by the private sector. ¹⁹⁵
Obtaining credit/financing	Obtaining credit can be grouped into five (5) major categories. They are the Commercial bank and micro-finance banks (e.g., Lift Above Poverty Organization – LAPO), Public finance schemes (e.g., the Central Bank of Nigeria’s Anchor Borrowers Programme and the Commercial Agricultural Credit Scheme), Value chain finance through supply aggregators, Informal investment schemes and remittances ¹⁹⁶ (popularly known as <i>ajo</i> in Yoruba, <i>esusu</i> in Igbo and <i>adashe</i> in the north), and cooperatives and associations. The availability of these financing options can be leveraged by starters

¹⁸⁹World Bank (2020) Doing Business: Comparing regulation in 190 Economies. <https://documents1.worldbank.org/curated/en/688761571934946384/pdf/Doing-Business-2020-Comparing-Business-Regulation-in-190-Economies.pdf>

¹⁹⁰ Nigerian Tribune (2022). FG Launches National Agricultural Technology, Innovation Policy. <https://tribuneonline.com/fg-launches-national-agricultural-technology-innovation-policy/>

¹⁹¹ Guardian (2021). CBN will frustrate attempts at maize importation – Godwin Emefiele. <https://guardian.ng/news/cbn-will-frustrate-attempts-at-maize-importation-godwin-emefiele/>

¹⁹² <https://farmersreviewafrica.com/nigeria-to-build-10-large-scale-integrated-rice-mills/>

¹⁹³ <https://www.premiumtimesng.com/news/more-news/500267-imota-rice-mill-to-start-production-2022-sanwo-olu.html>

¹⁹⁴ World Bank (2020) Doing Business: Comparing regulation in 190 Economies. <https://documents1.worldbank.org/curated/en/688761571934946384/pdf/Doing-Business-2020-Comparing-Business-Regulation-in-190-Economies.pdf>

¹⁹⁵ World Bank (2021). Nigeria to Improve Electricity Access and Services to Citizens. <https://www.worldbank.org/en/news/press-release/2021/02/05/nigeria-to-improve-electricity-access-and-services-to-citizens>

¹⁹⁶ Steamers S., Bagu B., Adams S. (2022). Addressing the \$200 billion demand for finance for Agriculture and Agribusiness in Nigeria. <https://www.rvo.nl/sites/default/files/2022-05/Finance-for-Agriculture-and-Agribusiness-in-Nigeria.pdf>

	of agribusiness. Popular sources of debt financing include Heritage Bank and the Nigeria Incentive-based Risk Sharing System for Agricultural Lending (NIRSAL). ¹⁹⁷ For loans, the interest given by a bank to an agribusiness firm engaged in primary trade is 100% tax-free if the loan has a moratorium of at least 12 months and the interest rate is not more than the base lending rate at the time the loan was provided. ¹⁹⁸
Paying taxes	<p>The Finance Act of 2019 changes specifies the main agricultural tax concessions for agribusinesses. Thus, companies involved in agricultural production will benefit from a 5-year tax holiday, which can be extended for an extra maximum of 3 years if agricultural output performs satisfactorily. ¹⁹⁹ Also, small agribusiness firms with a turnover of less than NGN 25 million and that have been in existence for less than 4 calendar years in operation are exempt from the minimum tax. ²⁰⁰ These have been put in place to reawaken and attract investors and ultimately promote the growth of agribusiness in Nigeria.</p> <p>Based on the tax incentives, a maximum of 5% of the Export Expansion Grant (EEG) rate is levied on agricultural exporters to promote the export of value-added/processed goods. The Export Credit Certificate (ECC) is an incentive provided by the EEG system that may be used to pay all federal taxes, including value-added tax (VAT), withholding tax, (WHT), and corporate income tax (CIT). ²⁰¹</p>
Trading across borders	The time it takes to export agricultural commodities has reduced with the upgrading of the electronic system and the launching of the e-payment of fees. This development is likely to encourage agribusiness firms to key into exporting their commodities. Akin to this is the provision of the requirement for the export of agricultural commodities on the website of the Nigerian Export Promotion Council (NEPC), which offers an e-registration option for potential exporters and the guideline for the export of agricultural commodities. ²⁰² The NEPC also promotes the export of agricultural commodities by providing training/sensitization to critical stakeholders and players in high-priority value chains as seen in the sensitization/training to stakeholders in Aba, Abia State. ²⁰³

¹⁹⁷USAID and GAIN (2017). Access to Start-up and Middle-level Equity Finance for Nigerian Agribusinesses: Postharvest Loss Alliance for Nutrition (PLAN) Learning Brief. <https://www.gainhealth.org/sites/default/files/publications/documents/gain-usaid-access-to-start-up-and-middle-level-equity-finance-for-nigerian-agribusinesses-2017.pdf>

¹⁹⁸ PWC (2022). Nigeria Corporate - Tax credits and incentives. <https://taxsummaries.pwc.com/nigeria/corporate/tax-credits-and-incentives>

¹⁹⁹ BDO (2020). Finance Act 2019 changes. <https://www.bdo.global/en-gb/microsites/tax-newsletters/corporate-tax-news/issue-54-march-2020/nigeria-finance-act-2019-changes>

²⁰⁰ BDO (2020). Finance Act 2019 changes. <https://www.bdo.global/en-gb/microsites/tax-newsletters/corporate-tax-news/issue-54-march-2020/nigeria-finance-act-2019-changes>

²⁰¹ PWC (2022). Nigeria Corporate - Tax credits and incentives. <https://taxsummaries.pwc.com/nigeria/corporate/tax-credits-and-incentives>

²⁰² NEPC (n.d.) <https://nepc.gov.ng/>

²⁰³ Vanguard (2021). NEPC sensitises farmers, others on export business. <https://www.vanguardngr.com/2021/11/nepc-sensitises-farmers-others-on-export-business/>

7.2 Access to Quality Inputs

Seed Systems



Key Takeaways

1. Crop breeding systems and harmonized seed agreements are critical to empowering a vibrant seed.
2. The Nigerian Seed system is weak and underdeveloped. Farmers lack access to quality seeds and the market value for improved seed varieties is unsustainable.

Quality seed is critical to productive, resilient, and sustainable cropping systems. An effective seed system in commodities such as rice is essential for food and nutritional security, especially considering that improved seed can account for up to 50% of the potential increase in crop yields. In Sub-Saharan Africa (SSA), only 10-20% of the seeds are obtained from formal sources, while the remaining 80-90% are provided informally.²⁰⁴

Countries' crop breeding systems and institutional and organizational arrangements are critical to providing conditions that enable a vibrant seed industry and vigorous private sector activity. Furthermore, seed varieties from one country might be apt and in fact advantageous for use in another country in the region or with similar agro-climatic conditions. However, excessive variety evaluation and registration processes, the absence or ineffectiveness of regional harmonization schemes, or lack of participation in international agreements are some of the issues that reduce the availability of improved seed varieties to farmers, raise their cost and/or limit innovation by domestic or regional firms.

In Africa, similar harmonized seed agreements have been developed by various Regional Economic Communities (RECs) such as the Economic Community of West African States (ECOWAS), West African Economic and Monetary Union (UEMOA), the Southern Africa Development Community (SADC), the Common Market for East and Southern Africa (COMESA), and the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). The harmonized seed rules were formulated to make seed trade faster, easier, and cheaper by avoiding repetitive national testing in each country and have aimed to incentivize the private sector to launch new and improved seed varieties.

These agreements shaped over a decade ago (e.g., ECOWAS in 2008) have initially been implemented quite slowly but are now at least partially operational in some member states. However, progress in Africa leaves much to be achieved. Authorities (such as customs in the case of ECOWAS member states) do not fully understand the rules and delay the movement of seeds.

Moreover, the regulatory process itself is fraught with inconsistency, inadequacy, and lack of transparency. Clear and consistent procedures and fees discourage attempts to certify seeds. There is also no legal framework currently in place for plant variety protection, and the ECOWAS system has not been supported by corresponding national and regional laws. Among regional regulators, collaboration and knowledge of national and regional rules related to seed are also low.²⁰⁵

The production of quality rice seeds is one of the major areas taken for granted by rice farmers. This is because farmers realize crop growth even from traditional seeds. However, the benefit of good seeds does not stop at crop growth. It also applies to grain quality and yield. Production of high-quality rice seed is an exacting task

²⁰⁴ India-Africa South-South Knowledge Exchange (SSKE) Webinar on "Seed Without Borders" Transnational Movement of Varieties and Seed February 22, 2022 (9:30 am to 12:00 pm GMT)

²⁰⁵ Seed Policy Harmonization in ECOWAS: The Case of Nigeria (Syngenta working paper)

thus seed producers take many steps to protect the genetic integrity of the seed.²⁰⁶ Rice varieties such as Faro 44 and 45, which are hybrids between local African rice and Taiwan rice, are increasingly performing quite well, especially in the Niger Delta region in Nigeria.²⁰⁷ Most of the seed companies interviewed revealed that they produce more FARO 44 seeds compared to other varieties because it is highly demanded by rice farmers due to its high yielding capacity. Figure 34 shows the gap analysis of the seed system in Nigeria.

Current Situation	Root Causes	Possible Solutions
<ul style="list-style-type: none"> While new rice varieties (e.g., Faro 44 and 45) are increasingly available, the production of quality rice seed, and availability of rice seeds at an affordable price, prove to be a challenge. 	<ul style="list-style-type: none"> The Nigerian seed system has been weak and underdeveloped Farmers lack access to improved varieties, good quality and certified seed The market value for improved seed is poor 	<ul style="list-style-type: none"> Local production of seeds of high yielding varieties must be increased Access to high-yielding improved varieties and extension services is imperative to increase productivity

Figure 34: Gap Analysis of the Seed System in Nigeria
Source: Derftdan Desk Research, 2022

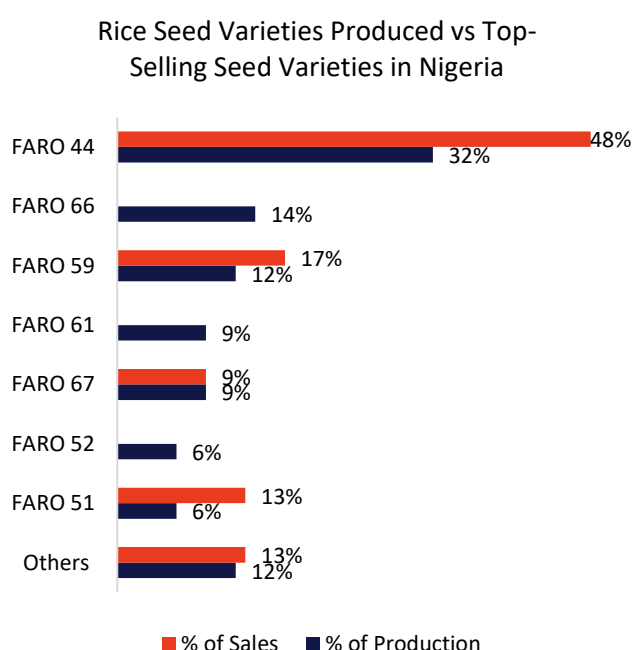


Figure 35: Types of Seed Varieties Produced by Seed Companies in Nigeria

Source: Derftdan Farmer Survey and KIIs, 2022

Others include: GAWAL R1, FARO 57, FUNAABOR 1, and FUNAABOR 2.

The Nigerian seed system has been weak and underdeveloped in supplying improved varieties. Weak infrastructure has played a role in the high costs of disseminating information on varieties. The existence of an informal seed sector partly fills these gaps, but seed qualities (variety identities and purities) are only imperfectly controlled by sellers concerned about reputations. In addition, demand for rice seeds in Nigeria can be seasonal,²⁰⁸ but the formal seed sector may not be flexible in adjusting the timing of seed supply.²⁰⁹ Seed stakeholders interviewed during the KIIs shared that their production choices are dependent on the seeds often required by farmers with location and ecology playing vital roles. Most farmers record low yields because there is no extension agents/ knowledgeable agro dealers within the seed system to properly inform them of which seeds to buy based on their location and ecology. Lowland rice varieties include FARO 44, 52, 59, 60, 61, 66, 67, and 69. FARO 58, 59, 63, and 64 are Upland rice varieties. On average, 10 out of the 15 seed stakeholders interviewed started

²⁰⁶ Akintunde A.P., Ejiogu L.C., Manta I.H. (2021). Empirical assessment of the trend in certified rice seeds production, productivity and price in Nigeria (2007-2017). <https://journalissues.org/ijapr/wp-content/uploads/sites/5/2021/05/Akintunde-et-al.pdf>

²⁰⁷ USDA and GAIN (2022). Grain and Feed Annual.

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Lagos_Nigeria_NI2022-0005.pdf

²⁰⁸ Takeshima, H. & Liverpool-Tasie, L. S. (2015). Fertilizer Subsidy, Political Influence, and Local Food Prices in Sub-Saharan Africa: Evidence from Nigeria. *Food Policy* 54: 11-24. <https://www.sciencedirect.com/science/article/abs/pii/S0306919215000408>

²⁰⁹ Gyimah-Brempong K., Johnson M., Takeshima A.H. (2016). The Nigerian Rice Economy: Policy Options for Transforming Production, Marketing, and Trade. <https://ng1lib.org/dl/3611559/b38866>

selling only two new varieties in the last 5 years.²¹⁰ Figure 35 depicts the types of seed varieties most commonly produced for the 11 seed companies interviewed in Nigeria, and the top-selling seed varieties for these companies. Note that the seed companies were asked to list their top two to three sellers, and all 11 unanimously listed Faro 44 as their top seller.

Compared to other countries, the Nigerian seed system is relatively poor in terms of regulations and the development cost of new varieties. According to the World Bank's Enabling the Business of Agriculture (EBA), the quality of the seed regulatory environment in Nigeria on a scale of 0 to 9 is 4. This is only the average of the index signifying that Nigeria's seed regulation is relatively weak. The cost to register a new cereal in Nigeria is approximately 171.6% of the average income per capita. In Uruguay, the highest-scoring country on the seed system indicator, the cost to register a new cereal is only 4.3% of income per capita and the quality of the seed regulatory environment is 8.²¹¹

Farmers lack access to improved varieties, good quality and certified seeds. Seeds are typically distributed through the Agricultural Development Program (ADP), which is a state-level agricultural extension agency. Also, only 10% of cultivated rice seed is from the formal system, which indicates that the farmers who plant improved seeds are very few.²¹² Smallholder rice farmers tend to increase production depending on the type and quality of improved seed available at the right time of planting.²¹³ Due to this lack of accessible improved seed varieties, Nigerian farmers rely on seeds from previous seasons which could affect the production of high-quality rice²¹⁴ and contribute to a low yield.²¹⁵ According to one of the seed stakeholders interviewed, parental seeds are expensive and difficult to multiply hence the challenge faced during the production of rice seed varieties. Another stakeholder also shared that in producing rice seed varieties, they often face challenges in sourcing breeder seeds which are often unavailable in research institutes.

The market value for improved seed is poor. Certified seed is the progeny of foundation seed, and it is grown by selected farmers to maintain sufficient varietal purity. Production is subject to field and seed inspections before approval from the certifying agency.²¹⁶ In a study by Rauf *et al*, most of the farmers surveyed complained about the poor, uncompetitive prices the seed companies offer for their seeds.²¹⁷ Poor market value for improved seed varieties is a critical factor that hinders the production and supply of good seeds for planting because the demand for improved seeds by smallholder farmers is low due to its expensive price. This restricts rice farmers to seeds from the previous season, which could undermine the output of quality rice after production and during post-harvesting. In this case, the low-quality produced rice could result in non-profitable production and count as a loss due to consumers' preference for high-quality, imported rice. This will also lead to a reduction in farmers' income.²¹⁸ Seed companies have also indicated difficulties producing seed varieties, with 8 out of 15 interviewed claiming financial challenges and 6 out of 15 citing institutional/regulatory challenges. Most recommended that the government provide financial support to seed companies, including subsidizing the purchase of first-generation seeds.²¹⁹

Strategies for developing the seed system in Nigeria:

²¹⁰ Rice Stakeholders KII, Derftdan (2022)

²¹¹ World Bank Group (2019) Enabling the Business of Agriculture. <https://eba.worldbank.org/en/data/exploretopics/seed>

²¹² KPMG (2019). Rice Industry Review. <https://assets.kpmg/content/dam/kpmg/ng/pdf/audit/rice-industry-review.pdf>

²¹³ Ojo, T. O., Ogundeji, A. A., Babu, S. C., & Alimi, T. (2020). Estimating financing gaps in rice production in Southwestern Nigeria. *Journal of Economic Structures*, 9(1). <https://doi.org/10.1186/s40008-020-0190-y>

²¹⁴ Ojo, T. O., Ogundeji, A. A., Babu, S. C., & Alimi, T. (2020). Estimating financing gaps in rice production in Southwestern Nigeria. *Journal of Economic Structures*, 9(1). <https://doi.org/10.1186/s40008-020-0190-y>

²¹⁵ The Guardian (2019). Substandard seeds, adulterated inputs threaten farm yields, food security. <https://guardian.ng/features/agro-care/substandard-seeds-adulterated-inputs-threaten-farm-yields-food-security/>

²¹⁶ Akintunde A.P., Ejiogu L.C., Manta I.H. (2021). Empirical assessment of the trend in certified rice seeds production, productivity and price in Nigeria (2007-2017). <https://journalissues.org/ijapr/wp-content/uploads/sites/5/2021/05/Akintunde-et-al.pdf>

²¹⁷ Rauf, A. J., Ojo, P. O., & Ocholi, A. (2017). Prospects and challenges of rice seed multiplication scheme in Benue state. *Journalcra.com*. <https://www.journalcra.com/sites/default/files/issue-pdf/23305.pdf>

²¹⁸ The Guardian (2019). Substandard seeds, adulterated inputs threaten farm yields, food security. <https://guardian.ng/features/agro-care/substandard-seeds-adulterated-inputs-threaten-farm-yields-food-security/>

²¹⁹ Rice Stakeholders KII, Derftdan (2022)

1. For Africa to attain food and nutrition security that will spur inclusive growth and development, local production of seeds of high-yielding varieties must be increased. These seeds should be tailored for specific ecological conditions to adapt to the changing climate and must also be disease and pest resistant.²²⁰ The seed gap in Nigeria ranges from 80% to 99% depending on the crop and about 13,976 tons of grain and pulse seeds are required to fill this gap annually.^{221,222} To this end, there is a need to rethink the formal seed system and extension service in Nigeria because access to high-yielding improved varieties and extension services is imperative to increase productivity in smallholder systems.²²³
2. There should be adequate funding for research institutions to develop high-yielding varieties that are adapted to flood, drought, and other biotic and abiotic stresses. In all, seeds produced in the market must be of high quality.
3. Improvement of the agricultural extension service to be more efficient and effective. The ratio of extension agents to farmers should be increased by encouraging participation from the government and private sector.
4. Establish demonstration farms that show Good Agricultural Practices (GAP) for sustainable rice production within localities.
5. Encourage competitiveness of seed production and commercialization to increase the supply of quality seeds.
6. Standardize the quality and price of seeds for rice producers.
7. Regional collaborations for seed development should be considered.
8. Ensure that the price for improved seed is affordable to farmers.
9. Put in place a plant variety protection system and implement national and regional laws that correspond to ECOWAS guidelines.
10. Develop mechanization or farm equipment hubs

Conclusion: Key opportunities for the seed system in Nigeria

Opportunity	Strategy	Action plan
Strengthen seed system	Develop a strong seed system to regulate the quality, price, and supply of seeds to farmers.	Regulate formal and informal seed producers to ensure the production and supply of quality seeds. Provide extension services to increase farmers' productivity. Introduce routine certification programs for seed companies.
Address access to improved varieties, good quality and certified seed	Ensure availability and accessibility of improved varieties for farmers by encouraging the production and distribution of certified seeds.	1. Encourage more local production/supply of improved seed varieties by providing training opportunities for farmers and youths in local communities. 2. Educate farmers on seed usage during specific ecological

²²⁰ Akintunde A.P., Ejiogu L.C., Manta I.H. (2021). Empirical assessment of the trend in certified rice seeds production, productivity and price in Nigeria (2007-2017). <https://journalissues.org/ijapr/wp-content/uploads/sites/5/2021/05/Akintunde-et-al.pdf>

²²¹ Collaborative Seed Program (2020). National Seed Road Map for Nigeria. https://cspnigeria.files.wordpress.com/2021/02/national-seed-road-map_nigeria-nasc-adopted.pdf

²²² IFC (2022). Climate Smart Agriculture Market Studies (unpublished).

²²³ Mghenyi, Elliot, Cora Dankers, James Thurlow, and Chidozie Anyiro. 2022. Transforming Agribusiness in Nigeria for Inclusive Recovery, Jobs Creation, and Poverty Reduction: Policy Reforms and Investment Priorities. International Development in Focus. Washington, DC: World Bank. doi:10.1596/978-1-4648-1724-3. <https://openknowledge.worldbank.org/bitstream/handle/10986/37132/9781464817243.pdf?sequence=1&isAllowed=y>

	Support the development of breeding programs.	<p>conditions to adapt to climate change and resist disease and pest.</p> <ol style="list-style-type: none"> 3. Provide funding for research and technical support in the development of improved seeds. 4. Further encourage the inclusion of private institutes and organizations.
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Other Inputs



Key Takeaways

1. Lack of coordination, incentives, and technical advisory lead to inefficient uses of inputs.
2. High quality inputs in Nigeria are used improperly due to limited access and lack of technical knowledge regarding input usage.

The high cost and inaccessibility of inputs, unavailability of inorganic fertilizers due to the Russian-Ukraine war, lack of subsidies, and lack of technical knowledge on the use of inputs are the gaps between farmers and input suppliers that contribute to low, unproductive yield.²²⁴ Figure 36 shows the gap analysis of farmers' access to quality inputs.

The fragmentation and lack of coordination between inputs supply, primary agriculture, and downstream off-farm agribusinesses are the foremost challenges constraining the growth of agribusiness value chains in Nigeria. This lack of coordination has persisted because of weak incentives for the private sector to invest in seed development and multiplication. The effect is farmers' limited use of improved inputs, including improved seeds and fertilizers, primarily because these inputs are not readily available to farmers and are often of poor quality.²²⁵

²²⁴ Sekumade, A.B., Toluwase, S. O., Owoeye, R. S. & Sedowo, M. O. (2019). Analysis of farm inputs distribution and information linkages among Farmers in Ekiti state, Nigeria. *Global Journal of Agricultural Research*, 7(4), 1-11. <https://www.eajournals.org/wp-content/uploads/Analysis-of-Farm-Inputs-Distribution-and-Information-Linkages-among-Farmers-in-Ekiti-State-Nigeria..pdf>

²²⁵ World Bank Group (2022). Transforming Agribusiness in Nigeria for Inclusive Recovery, Jobs Creation, and Poverty Reduction. <https://openknowledge.worldbank.org/bitstream/handle/10986/37132/9781464817243.pdf?sequence=1&isAllowed=y>

Current Situation	Root Causes	Possible Solutions
<ul style="list-style-type: none"> • Inefficient use of high-quality input due to limited access and lack of technical advisory on input usage. 	<ul style="list-style-type: none"> • Fragmentation and lack of coordination between inputs supply, primary agriculture, and downstream off-farm agribusinesses. • Lack of incentives in production and distribution, and smart subsidies in public fertilizer supply program. • Inadequate technical advisory services on input usage. • Inefficient use of fertilizers without improved seeds. 	<ul style="list-style-type: none"> • Improved access to seed and fertilizer can greatly improve food security and farm productivity in Nigeria. • Availability of high-quality and modern input will increase farmers' profit.

Figure 36: Gap Analysis of Access to Quality Input
Source: Derftdan Desk Research, 2022

Overall, Nigeria had an EBA score of 69.3% in registering fertilizer products; the cost to register a new fertilizer product as a percentage of income per capita is 5.2%, which is relatively low compared to other countries. However, the number of days it takes to register a new fertilizer product is long; 225 days. In addition, the quality of fertilizer regulation index on a scale of 0 to 6 is 2.²²⁶ Further, Nigeria imposes a restriction on fertilizer importation by requiring per-shipment import permits with a particular volume quota that is valid for 12 months.²²⁷

the quality of the seed regulatory environment in Nigeria on a scale of 0 to 9 is 4. This is only average of the index signifying that Nigeria's seed regulation is relatively weak. The cost to register a new cereal in Nigeria is approximately 171.6% of the average income per capita. In Uruguay, the highest scoring country on the seed system indicator, the cost to register a new cereal is only 4.3% of income per capita and the quality of the seed regulatory environment is 8

The lack of incentives in production and distribution, and smart subsidies in public fertilizer supply programs lead to inefficiency in the use of inorganic fertilizers. Smart subsidies can be provided to farmers who need to learn about the proper use of fertilizers or those who could use them but are limited by working capital constraints. These subsidies can be accompanied by effective extension and service delivery so that farmers can learn about such things as nutrient deficiencies in their plots, nutrient requirements for different crops, crop water requirements, and critical irrigation periods.

Farmers can also benefit from access to organic fertilizer systems. One example from China is the integrated rice-fish aquaculture system. The fish provides fertilizer to rice, regulates micro-climatic conditions, softens the soil, and eats larvae and weeds in the flooded fields while rice provides shade and food for fish. This reduces farmers' use of chemical fertilizers, pesticides, and herbicides for insect and weed control thereby saving both labor and input cost.²²⁸ Rice is cultivated in wetlands and the Niger delta region of Nigeria is a potential wetland that could be suitable for combining aquaculture with rice production. The Niger Delta in Nigeria is the largest wetland in Africa and currently has three sites listed as wetlands of international

²²⁶ World Bank Group (2019) Enabling the Business of Agriculture. <https://openknowledge.worldbank.org/bitstream/handle/10986/31804/9781464813870.pdf>

²²⁷ World Bank Group (2017) Enabling the Business of Agriculture <https://thedocs.worldbank.org/en/doc/929581534213514304-0050022018/original/EBA17FullReport17.pdf>

²²⁸ FAO GIAHS (2020). <https://www.fao.org/giahs/giahsaroundtheworld/designated-sites/asia-and-the-pacific/rice-fish-culture/en/>

importance by the Ramsar Convention.²²⁹ Other wetlands in Nigeria include but not limited to Sokoto-Rima, Lokoja wetlands, Jebba wetlands, Kaduna wetlands, Makurdi wetlands, and Komadugu Yobe.

Inadequate technical advisory services on input usage. Access to extension is limited because less than 10% of farmers in Nigeria receive technical advice on new seeds, pest control, and fertilizers.²³⁰ In addition, if agro-input dealers do not have any formal training on the product they sell, then they do not provide necessary advisory services to the farmers they serve. This lack of advisory services contributes to the use of fake and adulterated fertilizers, seeds, and agrochemicals.²³¹

Most farmers in Nigeria use fertilizers inefficiently and without improved seeds, primarily because of an inadequate supply of these inputs and poor design of input subsidy programs. Many times, farmers use the wrong products as well as unrecommended quantities for the type of soil on their farms. This is because soil testing is unavailable and could be expensive. On the one hand, under well-functioning input markets, farmers are unlikely to purchase fertilizers at full cost and combine them with traditional seeds because the returns to fertilizer are significantly lower with traditional seeds compared to improved seeds. On the other hand, farmers could end up using inorganic fertilizers together with traditional seeds if farmers can access fertilizers at less than the full cost through subsidy programs that don't provide fertilizers as a package with improved seeds.²³²

Increased use of fertilizer and improved seeds are partially credited with the large increases in agricultural productivity growth in Asia during the Green Revolution in the 1960s. Improved access to seeds and fertilizer can greatly improve food security and farm productivity in Nigeria. Farmers have a greater chance of profiting from the use of modern seeds and fertilizers if they are readily available, are of high quality, and are used effectively.²³³

Strategies to mitigate lack of access to quality inputs:

1. Timing and quantity. **Develop private-sector oriented trade financing tools that support improved and timely supply chain financing.** There is a general low input use and uncoordinated market linkage which often results in the untimely application of inputs. For example, the fertilizer market in Nigeria is dominated by government and dependent on budget allocation, distribution channels are immature, and distributors (e.g., importer to local agrochemical dealer) lack working capital and value chain finance to purchase stocks for peak season.²³⁴ It is very important to make high-quality inputs available to farmers on time and in enough quantity to increase their productivity. The introduction of subsidies alone will not solve the delay of inputs if the country's poor infrastructure and supply chains are not improved. While trade credit guarantees and funding for fertilizers have been explored by the AfDB and African Fertilizer and Agribusiness Partnership (AFAP) for enhancing the availability of distributor working capital, there is yet a need to further develop innovative trade financing tools that support improved supply chain financing by aggregating various delivery options.
2. Field recommendations. **Enhance farmer knowledge on managing uncertainties related to fertilizer applications for different types of farmland and weather conditions.** In rainfed lowlands, farmers may experience high levels of uncertainty about biophysical factors (erratic rainfall, insufficient water in the

²²⁹ Wetlands International. (2016). Conserving and restoring wetlands in Nigeria's Niger River Delta. <https://www.wetlands.org/casestudy/conserving-and-restoring-wetlands-in-nigerias-niger-river-delta/>

²³⁰ Sheahan, M. and Barrett, C. (2017). "Ten Striking Facts about Agricultural Input Use in Sub-Saharan Africa." *Food Policy* 67: 12–25.

²³¹ Vanguard News (2016). <https://www.vanguardngr.com/2016/04/fg-says-farmers-access-high-quality-farm-inputs-will-boost-productivity/>

²³² World Bank Group (2022). Transforming Agribusiness in Nigeria for Inclusive Recovery, Jobs Creation, and Poverty Reduction. <https://openknowledge.worldbank.org/bitstream/handle/10986/37132/9781464817243.pdf?sequence=1&isAllowed=y>

²³³ Sekumade, A. B., Toluwase, S. O. W., Owoeye, R. S., & Sedowo, M. O. (2019). Analysis of farm inputs distribution and information linkages among farmers in Ekiti State, Nigeria. *Global Journal of Agricultural Research*, 7(4), 1-11. <https://www.eajournals.org/wp-content/uploads/Analysis-of-Farm-Inputs-Distribution-and-Information-Linkages-among-Farmers-in-Ekiti-State-Nigeria..pdf>

²³⁴ AFAP. (2019). The Nigeria Fertilizer Value Chain: Impediments and Recommendations. <https://afap-partnership.org/wp-content/uploads/2019/10/AFAP-The-Nigeria-Fertilizer-Value-Chain-Impediments-and-Recommendations.pdf>

field, etc.), which are increasing with climate change, leading to the low use of inputs (e.g., fertilizer).²³⁵ To mitigate this challenge, there is a need for field-specific recommendations that consider soil texture and the spatial-temporal dynamics of water availability to reduce risk and uncertainty about biophysical factors and increase the use of fertilizers.²³⁶ For drought-prone conditions, water conservation measures, such as bunding, mulching, land-leveling, and no-tillage should also be considered for enhancing soil moisture and improving yield response to fertilizer. In addition, if reliable weather forecasting becomes available, it will help farmers to make timely decisions to reduce the risk and uncertainty related to climatic factors.²³⁷

Conclusion: Key opportunities for access to quality inputs

Opportunity	Strategy	Action plan
Increase technical advisory services on input usage.	Increase technical support.	Support technical advisory on input usage to farmers and extension agents.
Increase usage of fertilizers alongside improved seeds.	Design input finance programs that can leverage and assist entities such as micro-finance banks that have pre-existing relationships with farmers. In addition, ensure appropriate technical expertise is provided to the supporting entities.	Start open demonstration plots within localities to teach farmers good agricultural practices and techniques.

7.3 Commerce



Key Takeaways

1. The Nigerian rice market is marked by low prices, low specialization, and an underdeveloped value chain.
2. Most rice farmers (66%) do not face challenges when marketing their rice. However, those who do (34%) mainly face challenges with low prices and/or are negatively affected by poor road infrastructure.
3. Constraints to rice marketing include low capital bases and low credit coverage rates.
4. High transportation costs, few market channels, and nonexistent branding negatively impact the market demand for and prices of Nigerian rice.

The production of rice benefits both consumers and producers but the market for locally produced rice is a major problem. Despite the many advantages of rice to consumers and producers, a major problem of rice production is the marketing system which is the link between production and consumption.²³⁸ A market is any setting that allows buyers and sellers to exchange any type of goods and services. Rice marketing encompasses all the activities in moving rice from the point of production to where it is needed by final consumers. The

²³⁵ Arouna, A., Michler, J. D., Yergo, W. G., & Saito, K. (2021). One size fits all? Experimental evidence on the digital delivery of personalized extension advice in Nigeria. *American Journal of Agricultural Economics*, 103(2), 596-619. <https://onlinelibrary.wiley.com/doi/full/10.1111/ajae.12151>

²³⁶ Niang, A., Becker, M., Ewert, F., Tanaka, A., Dieng, I., & Saito, K. (2018). Yield variation of rainfed rice as affected by field water availability and N fertilizer use in central Benin. *Nutrient Cycling in Agroecosystems*, 110(2), 293-305. <https://link.springer.com/article/10.1007/s10705-017-9898-y>

²³⁷ Arouna, A., Devkota, K. P., Yergo, W. G., Saito, K., Frimpong, B. N., Adegbola, P. Y., ... & Usman, S. (2021). Assessing rice production sustainability performance indicators and their gaps in twelve sub-Saharan African countries. *Field Crops Research*, 271, 108263. <https://www.sciencedirect.com/science/article/pii/S0378429021002094>

²³⁸ Gona, A., Khalid A., & Maikasawa, M. A. (2020). Structure, conduct and performance of rice marketing in Kebbi state, Nigeria. *European Journal of Agriculture and Forestry Research*, 8(2).1-11. <https://www.eajournals.org/wp-content/uploads/Structure-Conduct-and-Performance-of-Rice-Marketing-in-Kebbi-State-Nigeria.pdf>

market for locally produced rice in Nigeria is characterized by low prices, it is not specialized, and has an underdeveloped value chain (Figure 37).

Rice marketing is the performance of all business activities in the flow of paddy and milled rice, from the point of initial rice production until they are in the hands of the ultimate consumers at the right time, in the right place and as convenient as possible, at a profit margin to keep the farmer in his farming operations.²³⁹ 34% of rice farmers surveyed reported that they face challenges when marketing their rice production. Of this group, 65% experience low prices and 43% are affected by poor road infrastructure, with some citing both as major concerns.²⁴⁰ One reason for this low sales price could be because they must sell off all their harvest almost immediately when the market price is low due to lack of storage. Although many of the rice farmers are price takers, they do not necessarily trade small volumes. According to the farmer survey, the average volume of rice harvested by farmers who sell at lower prices is 5.2 tons, compared with 4.2 tons by those who do not sell at lower prices.

Major constraints to rice marketing in Nigeria across all post-harvesting activities include poor rice quality, inadequate supply, lack of storage facility, market price fluctuations, low capital bases, a low credit recovery rate, and high cost of transportation. The following sections explain how commerce affects the post-harvesting parts of the rice the value chain in Nigeria.

Processing and storage

Grading and branding influence rice marketing. There is little to no branding of locally produced rice for domestic and international markets. Very few farmers/producers grade harvested products. 19 out of the 50 rice consumers interviewed could not name a single brand of locally processed rice in Nigeria.²⁴¹ This is one of the factors that negatively affect the standards, brand names, market demand and rice prices of the products.

Product quality affects the uptake of domestically produced and processed rice. Nigerian rice often has more particles, stones, and other debris mixed into the rice than foreign rice. 23 out of the 50 rice consumers interviewed cited the absence of particles and rocks as the major reason for their preference for a type of rice. Of the 13 consumers who preferred foreign rice, 10 of them perceived domestic rice as low quality and 8 mentioned improving rice quality and removing stones as their main recommendations for the Nigerian rice industry.²⁴²

Access to storage facilities and finance to buy in bulk during the harvest period enables processors to process paddy all year round. During scarcity, two of the processors shared that they had to source for paddy outside the country. Wholesalers and retailers often dictate the price of paddy at the farm gate and create an artificial glut by withdrawing from the purchase of rice for some time forcing farmers into panicking disposal of products at low prices. In the long run, price fluctuations affect the margin that the farmer gets.

Price fluctuation also affects milled rice; prices fall during harvest and rise during off-seasons. During the KIIs, rice processors shared that they often fix the price of milled rice based on demand and the amount spent to buy paddy from farmers' associations. When asked about challenges faced to produce rice seed varieties, one of the stakeholders interviewed shared that "market inconsistency and interference from the government affects sales plan and forecast."

Logistics and e-commerce

High transportation costs affect the rate of marketing of agricultural produce and the profitability of rice in Nigeria. These costs are often transferred to the final consumers who may be reluctant to buy at a higher price

²³⁹ Akinniran, T. N., & Faleye, G. R. (2020). Economics analysis of rice production and processing in Nigeria (1981 – 2019). *International Journal of Agriculture, Environment and Bioresearch*, 5(5), 113-132. https://ijaeb.org/uploads2020/AEB_05_557.pdf

²⁴⁰ Derftdan Farmer Survey (2022)

²⁴¹ Rice Consumers KII, Derftdan (2022)

²⁴² Rice Consumers KII, Derftdan (2022)

when compared with foreign/imported rice.²⁴³ In West and Central Africa, high transport prices and low service quality have been attributed to the lack of competition in the domestic market and large mark-ups by cartels of transport providers.²⁴⁴ One way to go around this monopoly is to make the sector attractive for foreign direct investments by improving trade relations with developed nations that have succeeded in using transportation to grow their economy. Further, investments in transportation and logistics are critical for attracting other investment opportunities as a well-connected road network facilitates the ease of movement for goods and services.²⁴⁵

Multiple marketing channels often influence rice prices. The more the channels, the higher the cost of paddy rice, so any rice that passes through all the five marketing channels namely farm/farm gate, primary market, secondary market, wholesale market, and urban market or processors will have a higher price compared to the rice that passes through only one or two channels.²³⁸ In addition, rice products sold via e-commerce channels have the tendency to be more expensive than those sold in walk-in shops. The increase in price is primarily a result of an added convenience fee and the cost of distribution to the customer’s doorstep.

Opportunities

With high demand for credit but low recovery rate, the opportunity for creditors is in redesigning credit facilities (such as ABP) that can better identify potential loan defaulters. A low capital base is a constraint because rice marketers have little or no access to loans except for those that belong to cooperative societies. Of the 50 rice market actors interviewed, 33 cited their lack of capital as a major constraint preventing them from increasing the scale of their trade. An additional problem of low credit coverage rate is because of customers do not fulfill their promises at a normal time agreed on, hence affecting the rice markets whenever credit sales are extended to the customers. For example, 29 of the 50 rice market actors interviewed said that customers are requesting more credit as compared to two years ago, but 25 noted that most or all do not pay their credit back on time.²⁴⁶ For example, ABP has been active since 2015. The program has faced loan repayment crisis due to a variety of reasons chief among which is the inability to pay and lack of willingness to pay. The seven years of data on recovery rate can be leveraged to better redesign the credit facility for optimal recovery.

Current Situation	Root Causes	Possible Solutions
<ul style="list-style-type: none"> •The farm gate price of rice is very low, as is the consumer perception of indigenous rice quality. 	<ul style="list-style-type: none"> •Lack of market price control •Marketing Channels •Most farmers/producers are dependent on traders who buy at predetermined low prices. •Low product quality 	<ul style="list-style-type: none"> •Improved transport to ease movement to the market •Farmers/Producers can be organized through farmers cooperatives and unions. This will make it possible for them to act collectively in providing cheaper inputs, applying recent agricultural technology, and to have influence on selling prices. •Improved handling processes to decrease pebbles and other impurities.

Figure 37: Gap Analysis of Marketing
Source: Derftdan Desk Research, 2022

²⁴³ Oteh, O. U., Agwu, N. M., Okpokiri, C., Aniuga, C., & Ani, L. O. (2018). Rice production and marketing in Nigeria: Assessing regulatory agencies’ role in positioning made in Nigeria goods. *Nigeria Agricultural Journal*, 49(2), 143-151. <https://www.ajol.info/index.php/naj/article/view/189460>

²⁴⁴ Rajasingham, S. (2012). Transport Costs in Africa: Why are they so high and what can be done about them. <https://devpolicy.org/transport-costs-in-africa-why-are-they-so-high-and-what-can-be-done-about-them20120302/>

²⁴⁵ Business Day. (2020). Nigeria transport industry as a destination hub for investors. <https://businessday.ng/interview/article/nigeria-transport-industry-as-a-destination-hub-for-investors/>

²⁴⁶ Rice Stakeholders KII, Derftdan (2022).

Other marketing challenges as shared by seed stakeholders during the KII include transportation, insistence on buying a particular volume of seeds by farmers and a low adoption rate of buying seeds as most farmers still believe they can replant seeds saved from previous harvests.

Conclusion: Key opportunities for marketing

Opportunity	Strategy	Action plan
Improve market price control	Reduce production costs	Aggregate farmers in clusters and develop out-grower model to engender shared resources thereby reducing the cost of production and limiting risks. This will influence the output/market price.
Increase product quality	Improve handling and transport processes to decrease pebbles and other impurities.	Facilitate improved farmer access to post-harvest processing technology. This can be achieved via: (1) Joint intervention programs with development organizations that intend to increase mechanization rates in rice producing regions (2) Another way to achieve this is by positioning the rice value chain for private investment through targeted marketing endeavors. For example, African Food Changemakers (formerly Nourishing Africa) is changing the narrative of African delicacies such as Jollof rice and Acha (fonio salad) through targeted campaigns that showcase their value and richness. ²⁴⁷ These activities have the potential to drive investment flow into the rice sector and increase the quality of milled rice, reduce post-harvest losses and contamination during and after processing.
Improve national aggregation and storage capacity for paddy and finished rice.	Provide Government-subsidized aggregation facilities in Local Government areas within major rice-producing states like Taraba, Kano, Cross River, etc.	Introduce local solutions for storage facilities such as locally fabricated mini silos. Provide effective and quality storage bags and train rice farmers and best-practice storage activities.
Adopt better rice branding and marketing strategies for local rice through information campaigns.	Push a national agenda for self-sufficiency and the need to buy made-in-Nigeria products particularly to cushion the effects of the Naira devaluation against the dollar.	First, ensure the production and processing of local rice are cost-competitive compared to imported rice. Then, launch a rebranding campaign.

²⁴⁷African Food Changemakers (2022). Goalkeepers 2022 on "Farm to Folk: Adapting to Feed the World." https://www.linkedin.com/posts/africanfoodchangemakers_goalkeepers2022-activity-6979349396735844352-Tfzo?utm_source=share&utm_medium=member_desktop

Opportunity	Strategy	Action plan
Redesign credit facilities for optimal recovery.	Use the seven years of data about loan recovery to redesign loan product.	Continuously update assumptions to better identify potential loan defaulters. Educate farmers on the difference between a loan and a grant.
Increase foreign participation in trucking and logistics services	Lower barrier to entry for the trucking and logistics market to increase foreign participation in the market Improve trade relations with developed nations such as Australia and Denmark that have succeeded in using transportation to grow their economy	Abolish restrictions on cabotage, backhauling, and triangular transport. For example, while cabotage can have positive effects in markets where the interest of the domestic services need to protected, it could increase competition and foreign participation in Nigeria, reduce prices and improve the quality of transport services in the agriculture sector. Actively collaborate with countries that have succeeded in using transportation to grow their economy with the goal of securing foreign direct investments and partnerships.

7.4 Irrigation and Water Control Investment



Key Takeaways

1. Lack of knowledge, inconsistent legal precedents, and high cost of inputs hinder attempts to irrigate Nigerian rice land.
2. Very little Nigerian rice land is irrigated, hurting efficiency and threatening food security.
3. Alternative sources of water e.g. groundwater, rainwater harvesting in earthen dams, and river diversion into rice fields are often ignored in favor of developing expensive irrigation systems.
4. However, more farmers are starting to cultivate rice twice a year thus integrating irrigation into their farming

Rice land in Nigeria is strikingly under-irrigated. Irrigation ensures good water control and two crops/annum with a yield potential of 5 tons to 6 tons per hectare.²⁴⁸ There is potentially about 4.2 million ha of cultivable rice land in Nigeria and only about 720,000 ha are currently installed with some form of irrigation facilities. Just about 60% of these facilities have full water control features which include a water head or dam while others have partial or seasonal water control systems.²⁴⁹ However, about 2.2 million ha currently classified as rain-fed lowlands could be transformed into full irrigated areas with a potential for 2 to 3 crops cycle per year. This would bring irrigated areas to a total of about 2.75 million ha. Nigeria also currently has 27 dams across the nation with a total capacity to irrigate 550,000 ha of rice farms.²⁵⁰ This shows huge potential for irrigation and water control investment in the country. Irrigation can help solve some of Nigeria's most pressing issues. For example, food security is a major challenge in Nigeria that is highly threatened by increasing food demand and declining water availability.

²⁴⁸ Ugalahi U. B., Adeoye S. O., Agbonlahor M. U. (2015). Irrigation potentials and rice self-sufficiency in Nigeria: A review. <https://academicjournals.org/journal/AJAR/article-full-text-pdf/0A6F6CF57016>

²⁴⁹ Federal Republic of Nigeria. Federal Ministry of Agriculture and Rural Development (FMARD). National Rice Development Strategy II. 2020 – 2030. https://riceforafrica.net/wp-content/uploads/2022/02/nigeria_nrds2-1.pdf

²⁵⁰ FMARD (2022). https://riceforafrica.net/wp-content/uploads/2022/02/nigeria_nrds2-1.pdf

The most cultivated rice varieties under irrigation in Nigeria include FARO 44, 52, 57, 60, and 61. The three main irrigation schemes that exist in Nigeria are (1) Formal irrigation schemes: public irrigation systems controlled by the government (2) Informal irrigation schemes: the farmer-owned and operated irrigation scheme, which receives assistance from the government in the form of workers for managing the operation and maintenance of the irrigation systems and occasional training²⁵¹ and (3) Traditional irrigation practice: e.g., the residual flood plain FADAMA. Figure 38 shows the gap in irrigation and water investment.

Current Situation	Root Causes	Possible Solutions
<ul style="list-style-type: none"> • Food security is threatened by increasing food demand and declining water availability. • A small percentage of rice is grown under controlled, irrigated systems which leaves production at risk to weather fluctuations, lower yields and only one production cycle. 	<ul style="list-style-type: none"> • Climate change • Farmers lack knowledge and technical know how of irrigation, equipment setup and management. • Too much focus on the development of expensive fully irrigated areas. 	<ul style="list-style-type: none"> • Education and awareness: Educate farmers on climate smart practices so they can produce all year round. Also educate them on irrigation setup and maintenance practices. • Explore other supplementary water supply sources.

Figure 38: Gap Analysis of Irrigation
Source: Derftdan Desk Research, 2022

There is too much focus on the development of large and expensive irrigating systems. Although Nigeria has abundant land and water resources, too much focus on the development of expensive, fully irrigated areas while ignoring other sources of the supplementary water supply has been a major challenge. Alternative sources of water include groundwater, rainwater harvesting in earthen dams, and river diversion into rice fields among others. From our desk research findings, irrigation is carried out mainly through tube wells, wash bores and open water sources. An intensive and consistent irrigated rice production scheme will set Nigeria on a pathway to rice self-sufficiency bringing an end to the gross loss in foreign exchange due to importation and smuggling of the commodity.²⁵² However, the prospects of achieving rice self-sufficiency through irrigation farming are hampered by:

- 1. Lack of knowledge/awareness on Irrigation farming techniques or lack of interest by smallholder farmers.** There is a low interest among farmers with regard to participation, operation, and maintenance of irrigation facilities due to poor knowledge of irrigation techniques. The level of utilization of the irrigation system is very low compared to the existing irrigation facilities. Also, the level of awareness of farmers regarding large-scale-scale irrigation systems in Nigeria is low.²⁵³
- 2. Weather conditions.** Irrigation sites and dams in Nigeria and neighboring countries are poorly managed and extreme weather conditions especially drought and floods make irrigation farming prone to disaster.
- 3. High cost of labor, inputs, irrigation equipment, and other operating costs.** Irrigation farming is a high capital-intensive production system and the minimal or non-existence of credit facilities for small-scale farmers has caused its low development. Labor is a very important factor in irrigation farming and water management. Irrigated rice production is labor intensive and further affected by rural-urban migration as mechanization in irrigation farming is low in Nigeria. Also, Irrigation farming

²⁵¹ News Agency of Nigeria (2022). <https://www.nannews.ng/2022/09/01/fg-hands-over-12-irrigation-schemes-to-kano-farmers/>

²⁵² Uduma, B. U., Samson, O. A., & Mure, U. A. (2016). Irrigation potentials and rice self-sufficiency in Nigeria: A review. *African Journal of Agricultural Research*, 11(5), 298-309

²⁵³ Bashir, A., & Kyung-Sook, C. (2018). A review of the evaluation of irrigation practice in Nigeria: Past, present and future prospects. *African Journal of Agricultural Research*, 13(40), 2087-2097. <https://academicjournals.org/journal/AJAR/article-full-text-pdf/3EAF05558713>

demands the use of more farming inputs of seeds, fertilizers, pesticides, and other chemicals. The high cost and low availability of these inputs result in a high cost of production in irrigation farming.

4. **Inconsistent and unimplemented policies and inappropriate legal framework.** Water and agriculture are regarded as separate entities under different ministries. This consideration has made both entities have different policies. The Federal Ministry of water resources (FMWR) is saddled with the policy formulation for irrigation development in Nigeria. However, the Federal Ministry of Agriculture and Rural Development (FMARD), State Irrigation Departments, and River Basin Development Authorities (RBDAs) have variant duties regarding irrigation development in Nigeria. Rather than complementing one another, the Ministries and the respective agencies have resorted to competing, leading to a fragmented and conflicting approach to irrigation development.

Strategies to mitigate irrigation and water control investment challenges:

1. Expanding irrigation systems in Nigeria would reduce some of the risks of the current system—lessening the impact of droughts that have contributed to widespread famine in the past and extending the productive growing season.²⁵⁴ Nevertheless, small-scale irrigation schemes might be more adaptable to farmers as the use of pumps or small reservoirs would give them more control. Also, small-scale irrigation schemes may prove to be more efficient than larger dams and other national irrigation systems that have fallen short in the past.
2. Capacity building on new rice production systems. Water-saving rice production systems that can be implemented include aerobic rice culture, system of rice intensification (SRI), ground-cover rice production system (GCRPS), raised beds, and alternate wetting and drying (AWD). These systems can drastically cut down unproductive water outflows and increase water-use efficiency (WUE).
3. Enable the purchase and even distribution of appropriate farm implements suitable for irrigation ecology as it will reduce drudgery involved in manual labor and the high cost of labor employed in rice irrigation farming.
4. Resuscitation and rehabilitation of existing irrigation facilities by the government.
5. Access to finance and special funding should be provided for irrigation development.
6. Private sector participation/investment should be explored with regard to dam and irrigation infrastructure development.
7. Technical support and capacity building after installations to tackle inadequate human capital development to manage the facilities.

Conclusion: Key opportunities for irrigation and water control investments

Opportunity	Strategy	Action plan
Address the high cost of labor, inputs, irrigation equipment and other operating costs.	Stakeholders and farmers should be encouraged to implement and install low costs irrigation systems. These include other sources of supplementary water supply like groundwater, rainwater harvesting in earthen dams, and river diversion into rice fields.	<ol style="list-style-type: none"> 1. Train farmers and extension agents on low-cost systems. 2. Provide relevant materials, and resources needed.

²⁵⁴ Liangzhi, Y., Hiroyuki, T. and Hua, X. (2018) Cultivating growth in Nigerian agriculture with small-scale irrigation. IFPRI Blog: Issue Post. <https://www.ifpri.org/blog/cultivating-growth-nigerian-agriculture-small-scale-irrigation>

Increase knowledge/awareness on Irrigation farming techniques or lack of interest by smallholder farmers.	Provide technical and financial assistance to farmers.	Increase the ratio of extension workers to farmers.
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7.5 Access to Equipment and Maintenance



Key Takeaways

1. Nigerian farmers lack access to agricultural equipment.
2. 79% of farmers reported difficulties accessing mechanization in their communities.
3. Lack of credit, low technical skills, and lack of access to spare parts make it difficult for Nigerian farmers to mechanize.
4. Lack of access to foreign exchange for the purchase of machinery from overseas and lack of skilled technicians for repair.

Demand: Rice Farmers and Farmer Associations

Access to farm resources plays a vital role in the adoption of any agricultural technology, which depends on the availability and efficient use of farm resources such as land, labor, knowledge, capital (credit) and farm inputs. In Africa, 80% of arable land is cultivated by human power, with only 5% by tractors.²⁵⁵ Only 7% of rice production is mechanized while the remaining activities are facilitated by draft animals and manual processes, accounting for 15% and 78% respectively.²⁵⁶

Nigerian farmers lack access to vital forms of agricultural technology. Nigeria's mechanization rate is low at 0.3 hp/hectare compared to India's 2.6 hp/ha, Vietnam's 2.2hp/ha and China's 8hp/ha. 79% of farmers find it either difficult or very difficult to access mechanization in their community. The number of agricultural tractors is estimated at around 22,000 in Nigeria, relative to 1 million in China and 2.5 million in India. Only an average of 3 out of every 10 rice farmers use machinery for their rice farming operations.²⁵⁷

The FAO identified mechanization as a key input for developing the agriculture sector in Sub-Saharan Africa, recommending a minimum of 1.5 hp/ha.²⁵⁸ The FGN has sought to enhance mechanization through several agriculture policy interventions. These range from the establishment of the National Centre for Agricultural Mechanization (NCAM) to the recent Mechanization Implementation Program (MIP).²⁵⁹

Similarly, many states have attempted to increase mechanization through the provision of subsidies for tractor hire. Through the MIP introduced in 2014, hiring centers were set up to enhance mechanization within the smallholder farmers through hiring services.²⁶⁰

In Nigeria, the introduction of machinery in rice threshing and harvesting can save up to 203 labor hours.²⁶¹ It can also reduce food loss, increase the amount of paddy yield per hectare, and improve the livelihood of small-

²⁵⁵ Food and Agri Strategic Advisory and Research (FASAR), YES BANK German Agribusiness Alliance at OAV. (2016). Farm Mechanization in India: The Custom Hiring Perspective. Government of India - Ministry of Agriculture and Farmers Welfare .1 (1), p12-43

²⁵⁶ Pham, T. V. (2016). Technical Solutions and Business Models for the Mechanisation of Small-holder Rice Production in Nigeria. Special Initiative One World - No Hunger. [online] Abuja, pp. p1-44. Available at: http://cariproject.org/wp-content/uploads/2016/05/Mechanisation-Report_15.04.2016.pdf

²⁵⁷ Derftdan Farmer Survey (2022)

²⁵⁸ PWC. Boosting rice production through increased mechanization. <https://www.pwc.com/ng/en/assets/pdf/boosting-rice-production.pdf>

²⁵⁹ The Guardian (2016). Ogbah Launches Agric Mechanisation Scheme. Available: <http://guardian.ng/features/ogbeh-launches-agric-mechanisation-scheme/>

²⁶⁰ PWC. Boosting rice production through increased mechanization. <https://www.pwc.com/ng/en/assets/pdf/boosting-rice-production.pdf>

²⁶¹ Soethoudt, H., Broeze, J. and Axmann, H. (2021). The impact of mechanization in smallholder rice production in Nigeria. Wageningen, The Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). <https://hdl.handle.net/10568/113959>

scale farmers. If Nigeria was to increase its mechanization rate from 0.3hp/ha to 0.8hp/ha, rice production could double as a result.²⁶² This would require Nigeria to triple its current stock of machinery. However, the cost of equipment, set-up, and maintenance is usually very high for farmers. Figure 39 shows the gap analysis for farmers' access to equipment and maintenance.

Current Situation	Root Causes	Possible Solutions
<ul style="list-style-type: none"> •The cost of acquisition, set up and maintenance of agricultural equipments is very high for smallscale farmers. 	<ul style="list-style-type: none"> •Lack of adequate credit facilities. •Low technical skills. •Lack of technical management experience. •Lack of access machine/equipment spare parts. 	<ul style="list-style-type: none"> •Farmer cooperatives can aid with equipment purchasing as it would help spread up-front cost across participating farmers. •Improve access to financing. •Local machine can be developed to avoid spare part scarcity. •Increase sharing/renting initiatives.

Figure 39: Gap Analysis of Access to Equipment and Maintenance

Source: Derftdan Desk Research, 2022

The lack of adequate credit facilities limits the adoption of agricultural technology and equipment. Smallholder farmers, who account for 80% of the agricultural production in Nigeria, have low income and limited access to credit facilities. Hence, the high acquisition and maintenance cost of agricultural machinery has limited farmers, including rice farmers' capacity for investment in agricultural machinery.

The low technical skills of farmers have constrained the adoption of mechanization. Without training, smallholder farmers do not have the technical capabilities to operate machinery and equipment. 42% of farmers surveyed reported that a reason for the current number of farmers using machinery was low awareness of mechanization²⁶³. In addition, the unavailability of experts and support services to maintain the equipment and manage rice plants is a major challenge.

There is a lack of experience at the mill level in managing new technologies. Investments in industrial milling are sometimes undertaken by actors who lack experience in managing the new technologies. Technological change requires millers to develop skills to master equipment and infrastructure, which involves hiring staff and properly training them. This is further buttressed by data from the KIIs as most of the rice processors interviewed indicated that they would be interested in any training that can upgrade the skills of their operational staff. Some processors revealed that they organize training for their operational staff from time to time but wish to have more training.

Access to machinery and equipment parts remains a challenge. Three out of the four stakeholders involved in rice processing shared that their milling equipment is imported with the only common local equipment previously used by them being parboilers and dryers. One of the major challenges they face is the high cost of spare parts for imported equipment which has been greatly affected by the high exchange rate. Unavailability of local markets for spare parts of imported milling equipment can hamper proper technology maintenance and provoke milling breakdowns.²⁶⁴ This situation is in contrast with global supply chains which are usually

²⁶² PWC (2019). Boosting rice production through increased mechanization. <https://www.pwc.com/ng/en/publications/boosting-rice-production-through-increased-mechanisation.html>

²⁶³ Derftdan Farmer Survey (2022)

²⁶⁴ Soullier, G., Demont, M., Arouna, A., Lançon, F., & Del Villar, P. M. (2020). The state of rice value chain upgrading in West Africa. *Global Food Security*, 25, 100365. <https://www.sciencedirect.com/science/article/pii/S2211912420300183>

close to equipment fabricators. Asian millers are directly supplied in the countries by equipment fabricators such as Alibaba in Thailand.²⁶⁵

One important benefit of improving access to equipment is increasing the population of youth involved in Nigerian rice farming. Currently, rice farming is dominated by the older generation. The average age of the rice farmers interviewed was approximately 44 years old.²⁶⁶ Increasing the amount of youth in farming will likely create more jobs, improve the food security situation, and increase the domestic yield of Nigerian rice. Youth may also be better at adopting innovative farmer technologies. To attract youth to rice farming, mechanizing agriculture and improving infrastructure, especially irrigation infrastructure, is necessary. This has been corroborated by Nigeria’s Minister of Science and Technology, Dr Ogbonnaya Onu,²⁶⁷ and other agricultural leaders.²⁶⁸ Other strategies involve increasing agricultural education, especially through hands-on programs implemented in elementary schools in agricultural communities.

Strategies to mitigate equipment and maintenance challenges

1. Increase mechanization services and technology to reduce the incidence of drudgery and production costs.
2. Fund research institutions to develop simple, appropriate, cost-effective, and intermediary machines.
3. Increase access to improved and affordable post-harvest machinery (threshing, milling, drying, destoning, grading, color sorting, etc.) through capacity building of indigenous fabricators or the establishments of private sector lead manufacturing/ assemblage entities.
4. Improve access to finance so that individuals and private organizations can acquire and run post-harvest /processing equipment hiring and leasing centers.

Conclusion: Key opportunities for access to equipment and maintenance

Opportunity	Strategy	Action plan
Address credit facility limitations to increase the adoption of agricultural technology and equipment.	Encourage farmers to come together in clusters or form cooperatives to aid with equipment purchasing. Local machines can be developed to avoid spare part scarcity. Increase sharing/renting initiatives.	<ol style="list-style-type: none"> 1. Encourage participation from private organizations. 2. Provide subsidies and credit facilities to farmer cooperatives. 3. Finance and promote local fabrication of machines by private and government bodies.
Creating awareness about youth inclusion.	Increase mechanization, access to infrastructure, and agricultural education.	<ol style="list-style-type: none"> 1. Subsidize modern farm equipment, such as tractors, for purchase by interested youth farmers. 2. Provide farmer inputs for students interested and willing to go into agriculture after college. 3. Institute fun educational programs in schools. These can involve providing seeds to students and tasking them with

²⁶⁵ Horadal, K. (2019). Rice milling in Thailand: crisis or opportunity. *Int. J. Manag. Appl. Sci.* 4, 44–47. [http://refhub.elsevier.com/S2211-9124\(20\)30018-3/sref30](http://refhub.elsevier.com/S2211-9124(20)30018-3/sref30)

²⁶⁶ Derftdan Farmer Survey (2022)

²⁶⁷ World Stage (2022). Nigeria to attract youths into agriculture through mechanized farming. <https://worldstagenews.com/nigeria-to-attract-youths-into-agriculture-through-mechanised-farming/>

²⁶⁸Punch (2018). How can FG make agriculture attractive to youths? <https://punchng.com/how-can-fg-make-agriculture-attractive-to-youths/#:~:text=Access%20to%20the%20Internet%2C%20potable,contribute%20meaningfully%20to%20the%20society.>

		growing the seed and "selling" it back to the school for money.
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Supply: Fabricators

The insights here are based on expert discussions with seven local fabricators and twelve service providers in Nigeria.

Box 2: Challenges and Opportunities for Local Fabricators and Service providers in the Rice Sector

Access to finance is a challenge. It was described as “very difficult” by all the fabricators, especially for facility acquisition or improvements, equipment financing, IT infrastructure, and working capital for business expansion. Only 2 out of the 12 fabricators interviewed pre-finance their clients by providing input credit to farmers. Also, only 1 out of 12 provide equipment services and the stakeholder mentioned that poor access to finance and high interest rates have prevented their organization from accessing and owning equipment.

The three top challenges limiting innovation among local fabricators are a **lack of integrated computer manufacturing** (design, model, simulation and production), a **lack of regulatory structure environment** (environmental, import/export compliance), and **low skill level among fabricators**.

Three of the fabricators develop rice production and processing machines from scratch. All of them, however, import their fabricating equipment/tools with 4 out of 7 convinced that the repairs made, and spare parts developed using the equipment compare favorably with imported ones. In addition, they all locally source the materials and other components like engines needed to repair other machines used for fabrication.

Fabricators have a role to play in the post-harvest and processing rice value chain in Nigeria. By fabricating local silos that are affordable to farmers for rice storage and automating farming systems with locally developed equipment for harvesting and threshing, post-harvest losses will reduce, and processing capacity will increase across the country.

Service Providers also have a role to play in the post-harvest and processing rice value chain in Nigeria. Service providers can play major roles across the rice value chain from planting to processing by providing seeds, fertilizer, equipment lease among other input and advisory services. To ensure this, proper attention needs to be paid to this sector with proper financing measures and policies put in place to assist stakeholders. Advisory services on good agricultural practices and input provision are the two top services provided by all the service providers to support their clients in addressing/ reducing rice harvest and post-harvest loss.

Source: Rice Stakeholders KII, Derftdan 2022

7.6 Storage system

Lack of storage quantity and quality is a major concern for Nigerian Rice Farmers. Across all stakeholders interviewed, improving storage facilities was mentioned as the chief suggestion for improving rice post-harvest in Nigeria. While the storage situation has ample room for improvement, 40% of the farmers interviewed do not store their rice. Of the 60% that do, 32% complained about poor storage quality and material.²⁶⁹ Low-quality storage practices can lead to mold, insects, and other factors contaminating the rice. Proper storage can also add value, aroma, and taste to the rice through the aging process.

²⁶⁹ Derftdan Farmer Survey (2022)

Total storage capacity in Nigeria is inadequate for Nigerian rice self-sustainability goals. Storage has been an integral aspect of China’s strategy to increase production while reducing post-harvest loss. As of 2021, China’s total rice storage capacity was 650 MMT. The NBS estimates that silos in Nigeria have a combined storage capacity of 1.3 MMT which is spread around 33 locations. However, the storage necessary for self-sustainability is 11-12M MT. This invariably means that 9 times the present storage capacity is required to achieve Nigeria's ideal storage capacity. Immediate creation of new silos and use of existing, previously unused silos is necessary for Nigerian rice self-sustainability.

To address the Nigerian storage deficiency, action is needed to both increase the quantity of silos available and the quality of the storage options. Figure 40 depicts a gap analysis of the storage situation in Nigeria. There is an upcoming regulation on electronic warehousing receipt systems (e-WRS) in Nigeria to tackle the challenges of storing agricultural commodities and as collateral for accessing loans. Warehousing of agricultural commodities in Nigeria has been faced with both infrastructural and managerial challenges.²⁷⁰ It has however passed a second reading by the senate and awaiting the concurrence of the house of assembly.²⁷¹

Current Situation	Root Causes	Possible Solutions
<ul style="list-style-type: none"> •There are not enough storage facilities for rice in Nigeria. •The storage facilities that are used are often of poor quality, allowing mold or insects to reduce rice quality. 	<ul style="list-style-type: none"> •Lack of credit to build or improve storage facilities. •Lack of guidance on what storage facilities will ensure rice quality and reduce post-harvest loss the most. •Lack of farmer education on best storage practices. 	<ul style="list-style-type: none"> •Introduce local solutions for storage facilities. This can be done by partnering with local fabricators to produce mini-silos. •Provide hands-on training and effective storage bags to farmers and storage facilities. •Subsidize large metal silos.

Figure 40: Gap Analysis of Storage Systems in Nigeria

Strategies to mitigate equipment and maintenance challenges

1. Seek investment from China. China has an extremely strong silo and grain storage development capacity. As they have invested in Nigerian infrastructure before, it is a viable option to seek investment and expertise from the Chinese once more.
2. Accelerate investment in local and commercial storage facilities. Local facilities are especially important to target, as they can provide storage to farmers who otherwise could not afford to store their rice at more expensive commercial facilities.
3. Partner with NGOs to provide educational programs to local farmers regarding storage.
4. Subsidize the sale of effective and quality storage bags to farmers and storage facilities.
5. Construct metal silos. Metal silos were integral to reducing post-harvest loss in China.²⁷² Although expensive, they will help reduce post-harvest loss in Nigeria.

Conclusion: Key opportunities for Storage Systems in Nigeria

Opportunity	Strategy	Action plan
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²⁷⁰ Derftdan. (2022). Nigerian Agribusiness Leaders Survey. <https://www.docdroid.net/to9Nfit/2022-nigerian-agribusiness-leaders-survey-report-pdf>

²⁷¹ AGRA. (2019). National Independent Warehouse Receipt System Bill Factbook. <https://agra.org/wp-content/uploads/2019/12/Nigeria-National-Warehouse-Receipt-System-Bill-Factbook.pdf>

²⁷² Luo, Y., Huang, D., Wu, L., & Zhu, J. (2022). The impact of metal silos on rice storage and storage losses in China. *Food Security*, 14(1), 81-92. <https://link.springer.com/article/10.1007/s12571-021-01194-4>

Address low quantity of storage facilities in Nigeria.	Both public and private sectors should increase investment in the construction of local and commercial facilities.	<ol style="list-style-type: none"> 1. Finance and promote local fabrication of storage systems by private and government bodies. 2. Seek investment from China, which has a robust grain storage system.
Address low quality of storage facilities in Nigeria.	<p>Construct storage facilities that are the most optimal for reducing post-harvest loss.</p> <p>Educate farmers and storers on storage best practices.</p>	<ol style="list-style-type: none"> 1. Focus construction of large commercial storage facilities like metal silos. These have proven valuable in the past to reduce post-harvest loss. 2. Provide effective and high-quality storage bags to farmers and storers. 3. Partner with NGOs to educate local farmers about storage.

7.7 Processing



Key Takeaways

1. Rice milling in Nigeria is a 'cottage industry' with more cottage processors than industrial processors across the country.
2. The choice of techniques and equipment used during processing is a major determinant of output and quality.
3. Cottage processors are faced with financial challenges that inform their choice of equipment while industrial processors face the challenge of inconsistency in grain quality and insufficient paddy.

Nigeria's rice processing techniques are inefficient. The quality of local rice is a major concern for the future of the Nigerian rice sector and paddy processing into rice is considered the most critical point for quality determination. Most processors are however unable to afford high quality processing equipment due to financial constraints and only 12 out of the 55 processors interviewed are using their current processing technology because it is efficient. Inefficient processing techniques eventually lead to processed rice that's too expensive while the cheap ones are of low quality.

There is a need to upgrade the capacity and technology of processors. Rice milling in Nigeria is a 'cottage industry' as there is a prevalence of small scale or cottage processing mills compared to large or industrial mills across the county. Currently in this wet planting season, aside from Kiara rice mill and a few other big millers, the cottage segment will likely procure more paddy from farmers than the big millers, especially now that the CBN ABP is under suspension. The need to upgrade the capacity and technology of cottage processors is strongly emphasized as they have been evidenced to be more competitive than industrial processors in delivering import quality parboiled table rice to consumers.²⁷³

Upgrading the capacity of cottage processors will also ensure they are able to better utilize processing capacity. The current installed capacity of all the cottage processors interviewed during the KIIs dropped significantly. The total combined installed processing capacity at the beginning of operations was 192 tonnes but the total combined current installed processing capacity is 93 tonnes as of the time of the interview.

Consistent quality and quantity of rice are important to ensure effective processing. Rice processors especially industrial processors encounter challenges with getting consistent quality and quantity of rice all year round. Industrial processors interviewed shared that though it is possible to source for paddy all year

²⁷³ Nigeria Agribusiness Register (2019). Report of the Panel Session on 'The State of the Nigeria Rice Industry & Way Forward for Competitiveness'

round, they often do not get up to the quantity they require. Paddy is often sourced by most of them from contract farmers, farmers, aggregators, traders, own farms, neighbouring states and open markets with contract farmers being the highest occurring source. Most cottage processors on the other hand source for paddy from farmers, contract farmers, traders, and their own farms with the highest number of interviewed stakeholders sourcing from farmers. Figure 41 depicts a gap analysis of rice processing in Nigeria.

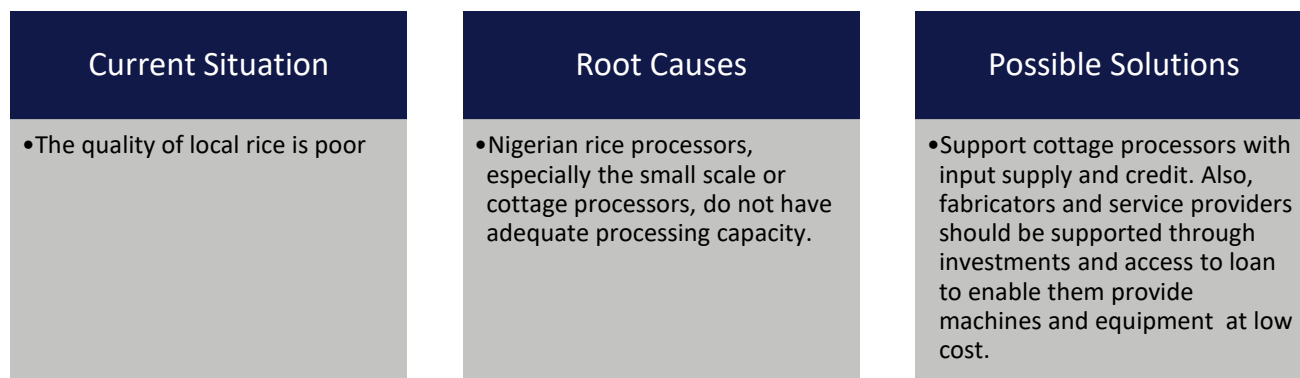


Figure 41: Gap Analysis of Processing
Source: Derftdan Desk Research, 2022

Strategies to mitigate processing challenges:

1. Stakeholders such as the federal and state agriculture ministries, local governments, and the private sector, should invest in modern high-quality rice processing equipment. This equipment should be subsidized, situated close to rice processors with good road access to prevent post-harvest loss and ensure that processors aren't burdened by the extra cost of transport and rice processing fees.
2. Float paddy aggregation centers.
3. Processors should pay increased attention to pre-milling and post-milling operations including winnowing paddy, drying, destoning, parboiling and eventually packaging as this will greatly improve the appearance and cleanliness of the rice delivered to the market.

Conclusion: Key opportunities for cottage and industrial processors

Opportunity	Strategy	Action plan
Increase quality through improved processing techniques.	Ensure modern and efficient rice processing equipment are affordable and made available to more processors.	1. Improve ease of access to loans by creating groups or cooperatives within communities and enable group purchase of equipment.

7.8 Others



Key Takeaways

1. Consumer rice preferences depend on a variety of factors including availability, disposable income, taste, quality, uniformity of size and shape.
2. Lack of funding for agricultural research hurts farmers' access to information and reduces the competitiveness of the Nigerian rice market.
3. Community mobilization can strengthen human resources and improve local decision making.
4. Farmer based organizations have the potential to promote development, but they must partner with the community to truly improve agricultural outcomes.

Consumer preferences and dietary trends

Locally processed rice is cheaper than imported rice but less clean. Some locally processed rice such as Ofada rice, Abakaliki rice, lake rice, Igbemo rice and Buhari rice have a distinct taste and aroma when cooked making them unique. For instance, in Northern Nigeria, preference is given to locally processed rice due to its ease in the preparation of certain local delicacies such as *tuwo shinkafa* and *kunu shinkafa*. Additionally, the preference for Ofada rice is highest among the local varieties of rice.²⁷⁴ Consequently, consumer preferences depend on a variety of factors including availability, disposable income, and taste. Nigerians eat rice in different ways such as jollof rice, fried rice, coconut rice, and plain rice. Jollof rice is arguably the most common delicacy in all parts of the country.

In terms of dietary trends, malnutrition represents a serious issue in Nigeria. 5 of the top 10 risk factors that drive disability and death in Nigeria are related to diets.²⁷⁵ Generally, food fortification is one of the major strategies advised by the World Health Organization and the Food and Agriculture Organization that could decrease the incidence of “hidden hunger” at the global level. Initiatives to facilitate large-scale fortification of rice with micronutrients such as iron and zinc are garnering attention from both the Nigerian government and international organizations like Global Alliance for Improved Nutrition (GAIN), HarvestPlus, and Global Fortification Data Exchange (GFDx).

Research and technology development

The National Cereals Research Institute (NCRI) is one of the agricultural research institutes in Nigeria established under the Federal Ministry of Agriculture and Rural Development. It has the national mandate for the genetic improvement of rice among other crops, and the development of technologies for the production and postharvest improvement of rice and the overall farming system of North Central Nigeria. It is also involved in extending its technologies through research on farmers' linkage systems.²⁷⁶

However, the lack of an agricultural research policy and strategy in Nigeria²⁷⁷ cripples R&D investment and management in both the public and private sectors. This lack of research policy contributes to the low impact of research funding on agricultural productivity, but farmers' access to information about agricultural-related

²⁷⁴ Adeyonu, A. G., Ajiboye, B. O., Aminu, T., Faronbi, O. A., Awe, T., & Olayiwola, I. E. (2019). Assessment of Consumers' Preference for Local Rice in South West, Nigeria. *International Journal of Research and Scientific Innovation*, 6(3), 141-144. <http://eprints.lmu.edu.ng/3441/>

²⁷⁵ GAIN (2022). The malnutrition challenge. <https://www.gainhealth.org/impact/countries/nigeria>

²⁷⁶ Danbaba N., Idakwo P.Y., Kassum A.L., Bristone C. Bakare S.O. Aliyu U., Kolo I.N., Abo M.E., Mohammed A., Abdulkadir A.N., Nkama I., Shehu H., Abosede A.O., Danbaba M.K. (2019). Rice Postharvest Technology in Nigeria: An Overview of Current Status, Constraints and Potentials for Sustainable Development. https://file.scirp.org/pdf/OALibJ_2019081215544369.pdf

²⁷⁷ Syngenta (2022). https://www.syngentafoundation.org/sites/g/files/zhg576/f/2021/11/25/reorienting_agri_rd_for_sustainability_in_nigeria_final.pdf

activities would improve productivity.²⁷⁸ Currently, only about 68% have access to price information weekly.²⁷⁹ Farmers with better access to information are more efficient than others with inadequate access to information.²⁸⁰ All the stakeholders during the KIIs mentioned that the rice research, development, innovation, and training capabilities in Nigeria compared to other rice-producing countries are low.

The current research ecosystem is disjointed and disorganized. National Agricultural Research Institutes (NARIs) have the mandates to fulfil their operations through collaboration with a variety of actors, including other research institutes. However, the structure of the Agricultural Research Council of Nigeria (ARCN) greatly reduces the effectiveness of the NARIs. Although the ARCN is supposed to coordinate all agricultural research activities, only the NARIs actually report to them. Other research institutes, with potentially valuable insights, report to other agencies. Moreover, the system lacks monitoring and evaluation frameworks, a key driver of China's agricultural success. Poor monitoring and evaluation frameworks also reduce accountability and demand-driven program design.²⁸¹ The recently adopted Agricultural Research Council Bill in 2021 has the potential to harmonize the boards of the NARIs with the Board of the ARCN and strengthen their coordination mandate, however it is not clear what the current status is.²⁸²

A critical challenge is inadequate funding for agricultural research activities. The amount appropriated by the government to research institutes is inadequate for implementing agricultural research programs. During the KIIs, all stakeholders mentioned the lack of adequate and sustainable funds as the major challenge within their organization. The funds disbursed to the institutes by the FGN are also usually lower than the appropriate amounts, which are already insufficient for research activities. Funds for rice research, development, innovation, and training in Nigeria often come from external and international donors.²⁸³

There is an absence of a defined funding mechanism for agricultural research activities. This often results in funding allocation by the Federal Government of Nigeria (FGN) based on political will, which leads to uncertainties regarding the future availability of adequate funding for research and poses difficulties for long-term research planning. Although the FGN, under the Maputo Declaration, committed to allocating at least 1% of its agricultural Gross Domestic Product (GDP) to agricultural research and development, the appropriation of funds by the FGN falls short of this commitment.²⁸⁴

The existing linkage gap between research and end-users has led to limited uptake of research technologies by farmers and the industry at large. The major factor responsible for this gap is the weak research-extension-farmer-input linkage systems. While the National Agricultural Research Institutes (NARIs) have units dedicated to extension service delivery, these units have either been neglected, leading to reduced capacity to deliver services or no longer exist.²⁸⁵

The competitiveness of the rice subsector in Nigeria cannot increase without yield growth and improvement of rice quality. There is an imperative to invest in research and development to generate high-yielding varieties and improve the quality attributes of local rice (taste, aroma, texture, and so on) under local growing conditions.²⁸⁶ Farmers need to have access to the findings and recommendations of research focused on improving rice production and post-harvesting processes. All four research institutions interviewed during the KIIs provide quality assurance and control services.

²⁷⁸ Khanal, U., Wilson, C., Shankar, S., Hoang, V. N., & Lee, B. (2018). Farm performance analysis: Technical efficiencies and technology gaps of Nepalese farmers in different agro-ecological regions. *Land use policy*, 76, 645-653. <https://www.sciencedirect.com/science/article/abs/pii/S0264837717315788>

²⁷⁹ Derftdan Farmer Survey (2022)

²⁸⁰ Ojo T.O., Ogundeji A.A., Babu S.C., and Alimi T. (2020). Estimating financing gaps in rice production in Southwestern Nigeria.

<https://journalofeconomicstructures.springeropen.com/track/pdf/10.1186/s40008-020-0190-y.pdf>

²⁸¹ Reorienting public agriculture R&D for achieving sustainable, nutritious and climate resilient food systems in Nigeria, Syngenta and Sahel 2021

²⁸² Cocoa Research Institute of Nigeria (CRIN) (2021). How ARCN Act Amendment Will Boost Agric. Research In Nigeria. <https://crin.gov.ng/2021/11/04/how-arcn-act-amendment-will-boost-agric-research-in-nigeria/>

²⁸³ Rice Stakeholders KII, Derftdan (2022)

²⁸⁴ Syngenta (2022). https://www.syngentafoundation.org/sites/g/files/zhg576/f/2021/11/25/reorienting_agri_rd_for_sustainability_in_nigeria_final.pdf

²⁸⁵ Syngenta (2022). https://www.syngentafoundation.org/sites/g/files/zhg576/f/2021/11/25/reorienting_agri_rd_for_sustainability_in_nigeria_final.pdf

²⁸⁶ World Bank Group (2022). Transforming Agribusiness in Nigeria for Inclusive Recovery, Jobs Creation, and Poverty Reduction.

<https://openknowledge.worldbank.org/bitstream/handle/10986/37132/9781464817243.pdf?sequence=1&isAllowed=y>

Community mobilization

Community mobilization is a powerful instrument in decentralizing policies and programs aimed at strengthening human and institutional resource development at the local level. It also strengthens the participation of rural individuals in local decision-making and improves their access to enhanced opportunities.

In Nigeria, for increased production or yield of staple foods, the rural community must legally secure entitlements to assets such as land, water, and technology, access to markets and microfinance, and the opportunity to participate in decentralized resource management.^{287,288}

However, there are a few challenges that hinder effective community mobilization in Nigeria including

The lack of increased awareness and sustainable commitment. This is the foremost setback in community mobilization and rural development in Nigeria. Nigeria has several rural development programs and policies but if the rural population, including farmers, is not aware of these programs and does not commit to them, then rural development is not feasible. Hence, the need for community mobilization.

Lack of community members' participation. It is the unified efforts of community members and other community-based organizations that help to initiate change in rural communities. When there is a lack of participation of community members in rural development, it will be difficult to build a common front towards improving the conditions of rural communities. In the case of rice farmers, participation in mobilization to improve access to high-quality input, equipment, and credit facilities will improve productivity.

Lack of transparency, local capacity, responsiveness, and accountability. These factors hinder the implementation and progress of community-driven development programs. The World Bank (2016) noted that when given clear and transparent rules, access to information, appropriate capacity and financial support, men and women can effectively organize to identify community priorities and address local problems by working together with local governments and other supportive institutions.²⁸⁹

The insights here are based on expert discussions with three implementing partners in Nigeria: Technoserve, Precision Development, and an NGO.

Box 3: Challenges and Opportunities for Implementing Partners

Major challenges facing the Nigerian rice sector as explained by three implementing partners include lack of support (with regards to policy, finance, and investment) and poor infrastructural services.

Implementing rice projects in Nigeria comes with its own challenges with the most mentioned by all stakeholders being accessibility and affordability of quality inputs and technology. Other challenges include lack of strategic aggregation centers, low number of extension service providers and lack of funds to ensure project continuity. Solving these challenges through subsidy, tax regime policy, training and deployment of more extension agents or backward integration will be of great benefit.

Source: Rice Stakeholders KII, Derftdan 2022

²⁸⁷ Selod, H., & Shilpi, F. (2021). Rural-urban migration in developing countries: Lessons from the literature. *Regional Science and Urban Economics*, 91, 103713. <https://www.sciencedirect.com/science/article/abs/pii/S0166046221000739>

²⁸⁸ Makkonen, T., & Kahila, P. (2021). Vitality policy as a tool for rural development in peripheral Finland. *Growth and Change*, 52(2), 706-726. <https://onlinelibrary.wiley.com/doi/abs/10.1111/grow.12364>

²⁸⁹ Ukah, J. A. (2017). Community mobilization awareness: strategy for rural development in Nigeria. *American Journal of Social Science Research*, 3(4), 12-16. https://www.researchgate.net/profile/Jonathan-Ukah/publication/359109043_Community_Mobilization_Awareness_Strategy_for_Rural_Development_in_Nigeria/links/622886a184ce8e5b4d139d50/Community-Mobilization-Awareness-Strategy-for-Rural-Development-in-Nigeria.pdf

Farmer-based organizations

One important example of community mobilization is farmer-based organizations. Farmer-based organizations have the potential to promote development within rural agricultural communities. Farmer organizations are formal or informal (registered or unregistered) membership-based collective action groups serving their members, who receive part or all their livelihood from agriculture (crops, livestock, fisheries and/or other rural activities). These organizations work to improve the livelihoods of their members through access to information, markets, inputs, and advocacy. Farmer organizations help small-scale producers with capacity building, aggregation of commodities, proper grading, and engagements with large buyers. Training and development help to further strengthen farmer organizations promoting their ability to ensure development within rural communities. Information distribution is one of the top services rendered by farmer organizations according to results from the KIIs conducted with representatives of farmer organizations. 3 out of 4 shared that they obtain information about rice market prices through market surveys which they've found reliable. Representatives also individually shared that their organizations facilitate external support for their members including capacity building, facilitation of loan and input credit, and tractor donation from the Federal Ministry of Agriculture amongst others. **Despite a long history of development projects organizing smallholder farmers into groups, farmer-based organizations are often ineffective.**²⁹⁰ Initiatives can actively focus on mobilizing local resources that will help achieve agricultural development.

Lack of skilled extension workers in rural communities. Extension plays a role in farmer-based organization development by linking research with community group needs. It also helps to facilitate appropriate technological development. However, there is a skill/knowledge gap, and most extension workers need to learn the principles of community-organizing and group management skills to help rural communities organize themselves for development. Agro-dealers who sometimes double as extension agents do not have enough knowledge and training on seed varieties. Seed stakeholders also shared that there is a lack of transparency amongst agro-dealers as some of them are not trustworthy and often fail to remit sales.

Pursue of short-term needs: Farmer organizations in Nigeria **tend to be weak**, and even cooperatives tend to pursue short-term needs rather than growth-oriented investments in productive assets, enforcement of quality standards and establishment of long-term relationships with buyers and suppliers.²⁹¹

Credit management

Financing issues impede the growth of rice stakeholders and value chain actors. In Africa, there is a lack of access to credit from the traditional financial sector where the poor represent the largest share of the population, and the informal sector represents an integral part of the economy. Of the farmers surveyed, 94% had never accessed loans before. 82% of those who had accessed loans received their loan from RIFAN. Only 3% of farmers received loans from a bank.²⁹² Of the 6 financial and insurance institutions interviewed, only 2 had specific products for rice value chain actors.²⁹³ Barring one notable outlier, none of the farmers interviewed received more than 1-20% of their credit from banks, the government, NGOs, or private organizations. 13 actors received anywhere between 61-100% from processors.²⁹⁴ Instead, 17 out of the 50 rice market actors interviewed make use of credit facilities from their suppliers. Moreover, a study conducted

²⁹⁰ Mghenyi, E., Dankers, C., Thurlow, J., & Anyiro, C. (2022). Transforming Agribusiness in Nigeria for Inclusive Recovery, Jobs Creation, and Poverty Reduction: Policy Reforms and Investment Priorities. World Bank, Washington, DC. © World Bank. <https://openknowledge.worldbank.org/handle/10986/35589>

²⁹¹ Mghenyi, E., Dankers, C., Thurlow, J. and Anyiro, C. (2021). Nigeria Transforming Agribusiness for Inclusive Recovery, Jobs Creation, and Poverty Reduction: Policy Reforms and Investment Priorities. World Bank, Washington, DC. © World Bank. <https://openknowledge.worldbank.org/handle/10986/35589> License: CC BY 3.0 IGO

²⁹² Derftdan Farmer Survey (2022)

²⁹³ Financial and Insurance Institutions KII, Derftdan (2022)

²⁹⁴ Rice Stakeholders KII, Derftdan (2022)

among rice farmers in Southwestern Nigeria discovered a financial shortfall of 80%, implying that farmers generally do not have the credit required to optimize their total rice production.²⁹⁵

In the processing domain, there is a funding gap between cottage rice processors and industrial rice processors. Although they are more prevalent, many cottage rice processors lack access to funding from banks and insurance institutions. 5 out of the 6 financial and insurance institutions interviewed did not service cottage rice processors. However, 4 out of 6 did service industrial rice processors.²⁹⁶

Most of the financing required by smallholder farmers and rural agro-MSMEs across the agricultural value chains in emerging markets is for the purchase of production inputs (improved seeds, fertilizers, and crop protection products). Limited access to credit leads to underinvestment in technologies for production and postharvest management. The growth of smallholder farmers is usually hampered by the limited access to credit, especially from banks, despite their significant contributions to economic development.²⁹⁷

In addition to farmers, millers and other value chain actors also face similar financial constraints. They rarely have access to formal credit from banks and rely on their savings, particularly when they are domestic actors. Three out of the fabricators interviewed during the KIIs mentioned that they only manufacture machines based on demand because of the high costs of production and lack of finance. This can imply that the locally fabricated machines are not readily available to farmers and processors who do not have enough finance. One service provider also shared that poor access to finance and high-interest rates have prevented them from accessing and owning a fleet of tractors.

Access to capital is vital for business growth and profitability and the lack of capital often prevents value chain actors from increasing the scale of their trade. Rice market actors during the KIIS further confirmed the importance of this problem, as lack of capital was among the top three challenges they listed as major constraints towards increasing the scale of their trade.

The reason for difficulties accessing credit is that commercial lenders are skeptical about providing credit facilities to smallholder farmers. The commercial lending sector tends to consider smallholder agriculture too risky, primarily because lenders face challenges in determining credible borrowers. Lenders also incur significant costs in processing many small loans to smallholder farmers. Furthermore, smallholders have weak land rights and face difficulties using land as collateral for commercial credit because most smallholders acquire land through inheritance without formal registration, unlike large-scale farmers.

The information on the financing (credit) gap can indicate to policymakers the intensification of rice production in Nigeria to meet its increasing rice demand and improve rice farmers' productivity.²⁹⁸ It is pertinent to note that access to credit facilities at reduced interest rates has incentivized farmers to grow rice which has contributed to increased rice cultivated areas, domestic production and created direct jobs.²⁹⁹ However, governmental support is critical to close the financing gap. Loan guarantees tacked on to existing lending programs and risk-sharing incentives, such as a robust regulatory environment, will also help bridge the financing gap.

Climate Resilient Agricultural Practices

Climate risks, exacerbated by global warming, have the potential to harm rice yield in Nigeria. Climate change in Nigeria has caused a highly irregular climate over the past few years, with the weather alternating

²⁹⁵Ojo, O. T., Ogundeji, A. A., Babu, S. C. & Alimi, T. (2020). Estimating financing gaps in rice production in Southwestern Nigeria. *Journal of Economic Structures*, 9(1), 1-18. <https://journalofeconomicstructures.springeropen.com/articles/10.1186/s40008-020-0190-y>

²⁹⁶Rice Financial and Insurance Institutions KII, Derftdan 2022

²⁹⁷Ojo, O. T., Ogundeji, A. A., Babu, S. C. & Alimi, T. (2020). Estimating financing gaps in rice production in Southwestern Nigeria. *Journal of Economic Structures*, 9(1), 1-18. <https://journalofeconomicstructures.springeropen.com/articles/10.1186/s40008-020-0190-y>

²⁹⁸Ojo, O. T., Ogundeji, A. A., Babu, S. C. & Alimi, T. (2020). Estimating financing gaps in rice production in Southwestern Nigeria. *Journal of Economic Structures*, 9(1), 1-18. <https://journalofeconomicstructures.springeropen.com/articles/10.1186/s40008-020-0190-y>

²⁹⁹AfDB & Stecia (2020). Study of Investment Climate Reforms in Selected Value Chains

between periods of extremely dry or rainy seasons.³⁰⁰ As established in 7.1 and 7.4, Nigerian farmers are very vulnerable to climate risks, especially droughts and floods. 76% of farmers interviewed reported inadequate rainfall in the last two to three years compared to rainfall five years ago.³⁰¹ A survey of 347 rice farmers in Ebonyi State found that the top three perceptions of Nigerian rice farmers regarding climate were increased intensity of rain, increased temperatures, and unpredictable patterns and distribution of rainfall.³⁰² These concerns do not bode well for the Nigerian rice market. A study conducted using rice output data from 1966 to 2015 found that rising temperatures and unpredictable rainfall adversely affected rice production.³⁰³ Nigerian rice farmers must implement climate resilient technologies to reduce the impact of climate change.

There is a need to develop drought, flood, and climate change resistant rice seed varieties. A study conducted in Niger state determined that the current Nigerian rice seed is not very resistant to changes in climate. Rice production fluctuates significantly with increases in temperature and humidity. The study concluded that there is a need to develop rice seeds that can resist the effects of climate change.³⁰⁴ These seeds should also be resistant to droughts and floods, as inconsistent rainfall is likely to cause either of the two.

Irrigation systems in conjunction with sustained index insurance can help reduce the impact of droughts and floods. As mentioned in 7.4, much of Nigerian rice cultivation is rainfed. Proper irrigation systems provide rice with consistent and evenly distributed water in case of droughts. In the case of floods, sustainable index insurance can be provided to reduce the impact of yield loss.³⁰⁵

Other climate resilient practices include:

- Aerobic Rice Cultivation
- Alternative Wetting and Drying (AWD) System
- The Ground-Cover Rice Production System
- Use of Raised Beds
- System of Rice Intensification
- Direct-Seeded Rice
- Drum-Seeded Rice

Government support is integral for the successful implementation of climate-resilient practices and technologies. Current government support is lacking. The creation of the Agricultural Promotion Policy, ratification of the Paris Agreement, and the development of a National Policy on Climate Change and Response Strategy (NPCCRS) were important first steps towards achieving sustainable development. There are also various local initiatives, often supported by NGOs, designed to bring climate-resilient practices to Nigerian agriculture. However, more remains to be done, especially in the realm of financing climate resilient technologies. A policy discourse integrating discussions from 252 stakeholders across Nigeria found that the leading challenge to implementing Climate Smart Technologies (CSA) is the lack of government funding.³⁰⁶ Potential solutions for addressing this funding gap include using international sources of climate finance, such as the Green Climate Fund. These funds could be directed through the National Agricultural Resilience branch

³⁰⁰Future Learn (2021). What are the impacts of climate change in Nigeria? <https://www.futurelearn.com/info/futurelearn-international/impacts-climate-change-in-nigeria#:~:text=The%20Nigerian%20climate%20has%20been,caused%20a%20loss%20of%20shelter>.

³⁰¹ Derftdan Farmer Survey (2022)

³⁰² Onyeneke, Robert & Amadi, Mark & Njoku, Chukwudi Loveday & Emmanuel, Osuji. (2021). Climate Change Perception and Uptake of Climate-Smart Agriculture in Rice Production in Ebonyi State, Nigeria. *Atmosphere*. 12. 1503. 10.3390/atmos12111503. https://www.researchgate.net/figure/Farmers-perception-of-climate-events_fig2_356246225

³⁰³ Abu BS, Abdur RS, Mohammad CR, Afroza C, Shajedur R, Limon D (2017). Rice farmers' technical efficiency under abiotic stresses in Bangladesh. *Asian Journal of Agriculture and Rural Development* 7(11):219-232.

³⁰⁴ Merem, E. C., Twumasi, Y., Wesley, J., Isokpehi, P., Shenge, M., Fageir, S., Crisler, M., Romorno, C., Hines, A., Hirse, G., Ochai, S., Leggett, S., & Nwagboso, E. (2017). Analyzing rice production issues in the Niger state area of Nigeria's middle belt. *Food and Public Health*, 7(1), 7–22. <https://doi.org/10.5923/j.fph.20170701.02>

³⁰⁵ Nigeria Agribusiness Register (2019). Report of the Panel Session on 'The State of the Nigeria Rice Industry & Way Forward for Competitiveness'

³⁰⁶ Ifeanyi-Obi C.C., Issa F.O., Aderinoye-Abdulwahab, S., Ayinde A.F., Umeh O.J., Tolongbose E.B. (2022). Promoting uptake and integration of climate smart agriculture technologies, innovations and management practices into policy and practice in Nigeria. <https://www.emerald.com/insight/content/doi/10.1108/IJCCSM-09-2021-0101/full/html>

of the Federal Ministry of Agriculture and Rural Development.³⁰⁷ The government could also enshrine these measures in their Nationally Determined Contributions (NDCs) to the Paris Agreement.³⁰⁸

The government, or an NGO, could also support training programs or related educational interventions. Farmers require training in climate resilient practices for these technologies to be used effectively. Although it is a concern for farmers, current climate training is practically nonexistent. 85% of farmers interviewed had not received any capacity building or intervention regarding climate change.³⁰⁹ The government could partner with an NGO to administer climate training to Nigerian rice farmers.

Transitioning to low carbon rice farming is essential for net-zero production. Rice paddies account for c. 20% of total global anthropological methane emissions. Flooding of rice paddies during growth generates methane-emitting bacteria and another major source of methane emissions is the decomposition of fertilizers and crop residues in flooded rice cultivation. In addition, rice farming is responsible for 2.5% of total global human-induced greenhouse gas (GHG) emissions.³¹⁰ As such, measures to reduce methane emissions in rice production are critical. However, cost of implementation which is currently high further increases as the time it takes to transition to net-zero increases. Some less expensive emission mitigation measures include mid-season drainage, a common irrigation practice in China and Japan, and system of rice intensification (SRI), a climate-smart practice that increases rice productivity, reduces water use and reduces methane emissions by up to 64%. SRI has already been piloted in 27 villages in Northern Nigeria by 1,350 small-holder farmers.³¹¹ A study on transforming Vietnam's rice production systems from a major source of GHG emissions to a sustainable low-carbon agriculture found that: (1) The application of technical options alone such as policy is insufficient to achieve net-zero emissions (2) However, policy is key especially in ensuring coherence and plan-budget alignment, repurposing public expenditures to support the transition, promoting public and private sector investments, and strengthening institutions (3) Digital and agronomic technologies add further benefits to the transition.³¹²

³⁰⁷ African Business (2022). Nigeria's farmers' loan programme faces repayment crisis. <https://cgspace.cgiar.org/handle/10568/106101>

³⁰⁸ Kenneth C (2022). Nigeria: The Need for Climate-Smart Agriculture. https://www.developmentdiaries.com/2022/06/nigeria-the-need-for-climate-smart-agriculture/?utm_source=rss&utm_medium=rss&utm_campaign=nigeria-the-need-for-climate-smart-agriculture

³⁰⁹ Derftdan Farmer Survey (2022)

³¹⁰ Tetra Tech International Development (2021). Reduced Methane Emissions Rice Production Project in Northern Nigeria using Systems of Rice Intensification (SRI). <https://sri-africa.net/wp-content/uploads/2021/10/SRI-n-Nigeria.pdf>

³¹¹ Tetra Tech International Development (2021). Reduced Methane Emissions Rice Production Project in Northern Nigeria using Systems of Rice Intensification (SRI). <https://sri-africa.net/wp-content/uploads/2021/10/SRI-n-Nigeria.pdf>

³¹² World Bank (2022). Spearheading Vietnam's Green Agricultural Transformation: Moving to Low-Carbon Rice. Washington, DC: World Bank.

8. Recommendations for the Nigerian Rice Value Chain

It is important to recognize that making the Nigeria rice value chain more competitive would not only contribute to economic growth and structural transformation but also solve developmental challenges. In Nigeria, actions need to be taken to further commercialize the rice subsector by facilitating more participation of the private sector and other stakeholders in the value chain.

There needs to be a sector-specific rice policy and advocacy platform to institute a rice sector policy dialogue and coordination of development interventions in the rice sector. This platform should comprise government and private stakeholders including monitoring and evaluation experts, farmers, processors, consumers, and all actors involved in the rice value chain. Examples of such platforms include the National Rice Development Council (NRDC) by the Nigerian Senate in 2022 and the Sustainable Rice Platform (SRP) developed via a multi-stakeholder collaboration among the Federal Ministry of Agriculture and Rural Development (FMARD), Competitive African Rice Initiative (CARI), and supported by UN Environment and the International Rice Research Institute (IRRI) in 2021. NRDC is still in the works and SRP aims to promote resource efficiency in rice production and champion sustainability both on-farm and throughout the supply chain.³¹³ The overarching goal of these multi-stakeholder initiatives and public-private partnerships is to accelerate development, build on the work of each stakeholder in different stages of the value chain, and drive collaborative work together.

Table 5 contains proposed action plans for the strategy, investment priorities, and mitigation of identified challenges discussed in earlier sections. It is important to emphasize that governments (from local to federal) need to do better in the area of implementation and training of monitoring and evaluation experts who will periodically assess the performance of suggested projects, programs and institutions established. In Table 6, we highlight the market potential of each portion of the value chain as it might interest the private sector. Based on the analysis of the opportunities, we present the priority investment destinations in decreasing order of market value.

Table 5: Action Plans for Improving the Rice Value Chain in Nigeria for the public sector

Stage of Value Chain	Recommended Action Plan ^{314,315,316}	Relevant Stakeholders
Seed production	<p><u>Context:</u> 57% of rice farmers in Nigeria source rice seeds from their own saved seeds, followed by 25% who source from agro-dealers.</p> <ol style="list-style-type: none"> 1. Increase the number of private seed companies in the development of new rice variety. 2. Develop and tailor new rice varieties according to consumer demand. 3. Capacity building through the training of young breeders (with at least 50% women) on advanced breeding tools and techniques. 4. Strengthen the community-based seed system (CBSS). 5. Increased the number of breeder and foundation seeds to seed companies and certified seed producers, respectively. 6. Ensure national and regional/state seed storage facilities across the country. In addition, seed harmonization in ECOWAS will facilitate regional promotion of new rice varieties entering the market. 	<ul style="list-style-type: none"> • FMARD • NCRI • Development Partners (DPs) • Universities • Private companies • Seed Entrepreneurs Dealers Association of Nigeria (SEEDAN)
Paddy production	<p><u>Context:</u> Average annual paddy produced per farmer in all 8 focus states ranges from 3,593 kg to 9,557 kg. The leading producers are Nasarawa and Kebbi.</p>	<ul style="list-style-type: none"> • FMARD • Federal, state, and local governments

³¹³ Blueprint (2021). <https://www.blueprint.ng/food-sufficiency-fg-cari-partner/>

³¹⁴ FMARD (2022). National Rice Development Strategy, Edition 2: 2020 - 2030. https://riceforafrica.net/wp-content/uploads/2022/02/nigeria_nrds2-1.pdf

³¹⁵ USAID-KAVES (2015). Maize Value Chain Analysis. https://pdf.usaid.gov/pdf_docs/PA00M2T3.pdf

³¹⁶ Okoye, Chukwuemeka. (2007). Proposal for establishment of a Nigerian rice network. https://www.researchgate.net/figure/Action-Plan-for-Rice-Sector-Investment-Strategies_tbl1_312136620

Stage of Value Chain	Recommended Action Plan ^{314,315,316}	Relevant Stakeholders
	<ol style="list-style-type: none"> 1. Unlock more performance and yield from states with the least production volumes such as Ebonyi (3,593 kg) and Cross river (3,595 kg). These states also have very low use of agrochemicals and mechanization. 2. Promote the increase in the average area of rice planted per household by smallholder farmers. This is feasible for states with large arable land such as Niger and Kebbi. 3. Organize rice smallholder farmers into clusters in their farming communities. 4. Reform the existing land tenure policies to give easy access to rice farmers in a contiguous area. 5. Provide training and capacity building of rice smallholder farmers on Good Agricultural Practices (GAP) for sustainable rice production. 6. Boost the number of both government and private sector extension agents. 7. Promote the application of more modern inputs and value chain management techniques in rice production. 	<ul style="list-style-type: none"> • RIFAN • Local farmers associations • NGOs • Presidential Initiative on increased rice production, processing, and export • Private sector
Input supply	<p><u>Context:</u> Rice farmers in Nasarawa, Kano, and Kebbi are familiar with inorganic fertilizers and use them. In addition, almost 75% of rice farmers grow early maturing rice.</p> <ol style="list-style-type: none"> 1. Review the agricultural input supply and distribution system to develop a sustainable private sector led system. 2. Strengthen the agro-inputs dealer association across different states to distribute quality standards for inputs to rice farmers. 3. Liaise with fertilizer producers and rice farmer groups to increase the uptake of tailored fertilizer suitable for the different ecological zones in Nigeria. Extension agents may be trained to advise farmers on suitable fertilizers for their type of farmland and weather conditions, 4. Encourage the purchase of fertilizer by smallholder farmers immediately after harvesting through training and extension. 5. Promote the use of other farm chemicals (pesticides, herbicides, fungicides) by the rice farmers. 6. Promote rural agro-input dealers networking for easy access by smallholder farmers. 	<ul style="list-style-type: none"> • FMARD • National Agency for Food and Drug Administration (NAFDAC) • SON • Private Sector • Agro-inputs Dealer Association • National Assembly
Mechanization	<p><u>Context:</u> Although an average of 15% of rice farmers cultivate rice with mechanized equipment, it is concentrated in Northern Nigeria. States like Edo and Ebonyi have almost non-existent mechanized rice farming.</p> <ol style="list-style-type: none"> 1. Promote the importance and benefits of mechanization to policymakers at the federal, state, and local governments level. 2. Promote awareness about the available and accessible mechanization services (planters, transplanters, harvesters etc.) open to farmers and farmers' groups. 3. Encourage exhibition for the local agricultural machinery manufacturers and fabricators to display their products. 4. Support smallholder farmer associations to collectively own tractors and other agricultural machinery. 5. Promote the adoption of animal traction and two-wheel tractors in rural communities instead of 100% manual cultivation. 6. Promote private sector investment in agricultural mechanization equipment. 7. Provide training at universities for youngsters to become technicians. 	<ul style="list-style-type: none"> • FMARD • Federal Ministry of Science and Technology (FMST) • Research Institutes (National Centre for Agricultural Mechanization - NCAM, federal and state university of Technology, etc.) • Regional and state government agencies like Projects Development Institute (PRODA)

Stage of Value Chain	Recommended Action Plan ^{314,315,316}	Relevant Stakeholders
	<p>8. Provide farm and mill operators with the relevant training they need to operate equipment and tools safely. This can be achieved by revamping extension services in the country.</p>	<ul style="list-style-type: none"> • Private sector • Financial Institutions/Funding agencies
Post-harvest management	<p><u>Context:</u> Significant amount of rice is wasted due to poor transport systems, inefficiencies in the local milling processes, and poor storage facilities.</p> <ol style="list-style-type: none"> 1. Accelerate investments in household and commercial storage facilities. 2. Organize capacity building for farmers and local processors on postharvest management techniques and practices. 3. Encourage the local development of postharvest technologies for individual farmers or farmers' groups. 4. Promote postharvest machinery hiring and service centres around rice farming and processing clusters. 5. Facilitate farmer groups' access to finance for the acquisition of post-harvest machinery. 6. Upgrade the existing post-harvest technology in the rice farming and processing clusters. 	<ul style="list-style-type: none"> • FMARD • Development partners • NGOs • Financial Institutions/Funding agencies • Research Institutions, (e.g., NCAM, NCRI, AfricaRice Centre) • Private sector • Paddy Rice Dealers Association of Nigeria (PRIDAN) • Federal, state, and local governments
Processing	<p><u>Context:</u> Despite the challenges that beset cottage processors, they are the closest link to smallholder rice farmers, hence are essential in the Nigerian rice value chain. Medium to large millers, on the other hand, run their mills below-installed capacity due to lack of quality paddy.</p> <ol style="list-style-type: none"> 1. Develop local milling clusters and shared facilities through industrial park establishment with the help of local and foreign investors such as the Chinese. Large industrial processors could also be linked with cottage processors in such a cluster. This will improve the combined capacity of cottage processors and extend the footprint of large industrial processors. 2. Upskill cottage processors through training. 3. Provide a supportive climate for accessing funds, equipment, and inputs. This could be credit or through umbrella associations such as Rice Processors Association of Nigeria (RIPAN) and National Rice Producers, Processors, Millers and Marketers Association of Nigeria (NARPPMMAN). 4. Encourage technology transfer between universities and industry, especially in agricultural engineering. This can be achieved through the mandatory industrial training program for university students under the Industrial Training Fund (ITF). 5. For medium to large millers, facilitate an increase in rice production or yield of commercial and smallholder farmers through easy access to land and high-quality inputs such as seed and agrochemicals. Complement increased production with more storage facilities and capacity by financing Paddy Aggregation Centers. 	<ul style="list-style-type: none"> • RIPAN • Financial Institutions/Funding agencies • Federal, state, and local governments • ITF • Universities • Processors (both cottage and industrial)
Trade and commerce	<p><u>Context:</u> Several factors affect the trade of rice in Nigeria and facilitating an enabling environment for commerce is key to unlocking more value. Nigeria places high effective duty rates of 70% (10% tariff and 60% levy) on rice imports by sea and has banned imports through land borders altogether to</p>	<ul style="list-style-type: none"> • Private sector • Federal, state, and local governments

Stage of Value Chain	Recommended Action Plan ^{314,315,316}	Relevant Stakeholders
	<p>boost the competitiveness of the local industry.³¹⁷ To further pull investment into rice production, the Nigerian Senate passed a bill that would save about USD 2 billion on rice importation. The bill aims to accomplish its goals by establishing governance and operational structure to drive development.³¹⁸</p> <ol style="list-style-type: none"> 1. Develop a roadmap to guide the rice value chain into self-sufficiency. 2. Develop public-private partnerships to connect rice traders to farmers or aggregators. 3. Use a PPP platform to facilitate access to credit as this is a major pain point for rice traders. 4. Stabilize policies on rice import and price control. 	<ul style="list-style-type: none"> • Rice aggregators and dealers. E.g., WACOT, Paddy Rice Dealers Association of Nigeria (PRIDAN)
Consumption	<p><u>Context:</u> Despite its acclaimed high taste and aroma, the low quality of processed local rice needs urgent attention. The presence of stones and other foreign materials affects its acceptability in the market.</p> <ol style="list-style-type: none"> 1. Improve the output and quality of local rice by providing processors with capital or accessible loans to allow for investment in quality equipment. 2. Encourage proper branding and packaging services 3. Institute an association or organization for processors to monitor and ensure that all processors within the associations are encouraged to engage in quality checks and assurance before final packaging and marketing. 	<ul style="list-style-type: none"> • Financial Institutions/ Funding agencies • Federal, state, and local governments • SON • Private Sector

Table 6: Market opportunities in various stages of the rice value chain in Nigeria for the private sector

Stage of Value Chain	Market opportunities
Seed production and input supply	<p>The seed gap in Nigeria ranges from 80% to 99%. According to the Membership of National Agricultural Seeds Council (NASC), there are 314 formal seed businesses in Nigeria. Taking a median seed gap of 91%, the number of additional seed businesses required amounts to 3,489. Assuming a USD 30,000 investment per business (both new and existing), the investment demand for the propagation and distribution of seeds and planting material is around USD 30.9 million. This figure further assumes a 30% potential realization of the market opportunity.</p>
Mechanization	<p>Assuming that reapers and threshers are the key mechanized equipment for rice production and only 30% of the potential market opportunity in Nigeria is captured, the market size is USD700 million.</p> <p>This is based on the assumption that reapers can be used on 80% of the rice area in Nigeria and small-scale threshers would be used for 80% of the rice production. With a rice cultivation area of 5.5 million ha/year in Nigeria, average cost of a 1 ha/day reaper being c. USD 2050 to be used for 100 days/year, the annual investment demand for reapers amounts to USD 90.2 million. Applying a similar logic to threshers while assuming a utilization capacity of 1080 tons/year at USD 875 per thresher, we arrive at the total investment demand for both equipment.</p>
Irrigation	<p>Irrigation infrastructure is key for both wet and dry season rice farming in Nigeria. According to Xie et al., (2017), the additional economically irrigable area in Nigeria is 1 million ha. Assuming a small-scale gravity drive drip irrigation (no pumps) that costs USD 1800 is required per ha, the total investment demand is USD 1.8 billion. At a 30% potential, the market opportunity is USD 540 million.</p>

³¹⁷ International Trade Administration (n.d). <https://www.trade.gov/country-commercial-guides/nigeria-import-tariffs>

³¹⁸ Daily Post (2022). <https://dailypost.ng/2022/01/19/nigeria-to-save-2bn-annually-on-rice-importation-senate/>

Stage of Value Chain	Market opportunities
Post-harvest and storage	In 2021, the national rice production in Nigeria was 7.94 million tons. The cost of installing a grain bin storage is calculated based on the assumption that a small 250-ton grain bin storage with agitator turnkey will be sufficient. The cost of one such grain bin storage is USD 140 per ton. At 30% potential, the market demand for rice storage is USD 333.6 million.
Trade and Commerce	The annual market opportunity in trading rice is USD 614.4 million at a price of USD 0.86 per kg and 30% potential. However, this potential is dependent on how well the preceding portions of the value chain are aligned in terms of quality and quantity of rice that gets to the market.

Sources: Soethoudt, J. M., Broeze, J., Axmann, H. B. (2021). The impact of mechanization in smallholder rice production in Nigeria : promising business cases for rice smallholders for income increasing and climate smart interventions. (Report / Wageningen Food & Biobased Research; No. 2182). Wageningen Food & Biobased Research. <https://doi.org/10.18174/550445>. Collaborative Seed Program (2020). National Seed Road Map for Nigeria. https://cspnigeria.files.wordpress.com/2021/02/national-seed-road-map_nigeria-nasc-adopted.pdf. IFC (2022). Climate Smart Agriculture Market Studies (unpublished). World bank (2021). Population, total – Nigeria. <https://data.worldbank.org/indicator/SP.POP.TOTL?locations=NG>. KPMG (2019). Rice Industry Review. <https://assets.kpmg/content/dam/kpmg/ng/pdf/audit/rice-industry-review.pdf>. NASC (n.d.). List of Licensed Seed Entrepreneurs in Nigeria. <https://seedcouncil.gov.ng/seed-producers/>

8.1 Investment Priorities

Investment along the supply chain will benefit all actors, promoting access to finance, capacity building, and technical support. While more value can be unlocked from all the segments of the Nigerian rice value chain with targeted investment actions, some segments such as input (seeds, mechanization, agrochemicals), processing, and training on post-harvest losses and storage needs more attention than others (Figure 42).

For example, one of the biggest risks associated with investment in rice processing are the epileptic power supply in the country. By siting a rice milling firm in one of the special economic zones where there is uninterrupted power supply, investors can have confidence that the risk has been mitigated. Proximity to ports for lower cost of logistics in transporting machine spare parts or complete machines is another consideration. The Lekki free trade zone is proximate to Lekki port and has a dedicated customs management for import/export. Other special economic zones include Ogun - Guangdong free trade zone, Kano economic city project, and Enyimba economic zone. Figure 42 highlights the investment priorities in high-value portions of the rice value chain based on the analysis in Table 6.



Figure 42: Investment Priorities Across the Rice Value Chain
Source: Derftdan Desk Research, 2022

8.2 Conclusion

Nigeria is one of the fastest growing and highest-opportunity rice markets in the world. Nigeria is the top rice producer in Africa, largely thanks to its growing population, substantial amount of arable land, government support for production practices, and use of hybrid seeds. Still, rice yields in Nigeria are about half of the average yields in Asia and demand for rice consistently exceeds supply. The main reason for this is that the input, post-harvest, and processing sectors lag behind the rest of the Nigerian rice market.

Key opportunities are observed in improving post-harvest and processing components of the value chain. The current post-harvest and processing segment is scattered and largely unintegrated. Rice post-harvest and processing are behind in capacity, productivity, technology adaptation, and especially the prevention of post-harvest loss. If Nigeria was to implement best-practice reforms to this section of the value chain, it could significantly ramp up rice production, both for domestic consumption and export.

Investment opportunities lie all along the supply chain, from farmers and seed companies to processing mills and fabricators. Investments will greatly benefit all actors, promoting access to finance, capacity building, and technical support.

Specific opportunities include ensuring access to quality inputs, improving the rice marketing process, irrigating Nigerian rice land, and increasing mechanization. Other opportunities lie in leveraging community mobilization, improving R&D, and partnering with farmer organizations. To address these problems efficiently and effectively, Nigeria could draw inspiration from the world's foremost rice-producing nation: China.

Key policies on rice standards, especially specific grading standards need to be established by SON or a relevant body to improve the quality and the price structure of rice in the country. In addition, actionable policies should be put in place to gear national budget allocation toward investment in research and development (R&D) for bolstering seed innovation and developing seed varieties that are adaptable to the local climate of Nigeria and can withstand droughts, floods, and inconsistent temperatures.

Supporting trade and commerce will help build resiliency into the rice value chain. Providing adequate structural support across warehousing, transportation, advertising, finance, and insurance services to relevant actors across the rice value chain will ensure resilience. An improvement in the quality and reduction in the price of processed local rice will encourage consumption. Stakeholders including the government and private organizations can play vital roles in reducing the production and processing costs for farmers and processors ultimately reducing the final price at which local rice is sold to customers.

The Nigerian rice industry is dominated by cottage processors who with the right support and enabling environment, have the potential to unlock more value from Nigeria's rice value chain. In addition, cottage processors are sustainable market channels for small-holder farmers. The cottage processing industry is a sustainable source of off-take for farmers' paddy and thus should be given attention in any discussion to strengthen the rice value chain in Nigeria.

Nigeria can learn a lot from China's rice industry success. China is the world's largest rice producer and consumer. Chinese success can be attributed to technology-enabled post-harvest operations, government-subsidized mechanization, and farmer-led supply chains to mobilize household resources. By adopting similar approaches, Nigeria can use China's track record of rice-related achievements to accelerate its own rice market.