This document is an extract from:
Data collection survey on rice related programs/projects in the CARD member countries (with Study on the local rice competitiveness in 15 selected countries) : Final Report. -- Japan International Cooperation Agency : NTC International Co., Ltd. : RECS International Inc., 2021. 8, Annex A.

Competitiveness Analysis of Local Rice to Imported Rice
Nigeria

1. Objectives and outline of the analysis

The program of CARD2, launched in 2019, aims to increase rice production in Sub-Saharan Africa from 28 million tons to 56 million tons by 2030. The competitiveness of local rice against imported rice would be an important aspect to look into to achieve this aim. Given this context, a study comparing the competitiveness of local and imported rice for 15 countries[1]. was implemented by Japan International Cooperation Agency (JICA) from February to August 2021.

With relentless efforts in rice sector development, the competitiveness of the locally produced rice against imported rice has been recently improving in Sub-Saharan African countries. However, the pace of development in local rice is not sufficient due to the rapid expansion in demand. In addition, local rice often faces competition from imported rice. The main objective of this survey was to analyze the competitiveness of major local rice varieties against imported rice. DRC (domestic resource cost) approach was applied to quantitatively analyze the competitiveness, and sensitivity analysis to discuss the achievable approach to improve it. The competitiveness analysis should be updated as more information becomes available, since the situation on the rice sector in Sub-Saharan Africa is constantly changing and the information in the current survey was very limited.

2. Local rice and imported rice

2.1. Comparison of local rice and imported rice

Nigeria is the largest rice producing country in Africa but it used to be the second largest rice importer in the world (FAO, 2013). In recent years, rice production has been increasing with the similar pace as increasing demand, and maintaining a high self-sufficiency rate of 84 – 99% (Fig. 1). Most of the rice farmers in Nigeria are smallholders (90% of total), applying production method with minimum input requirement.

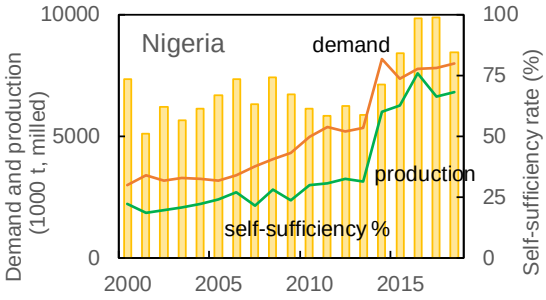


Fig. 1. Rice supply in Nigeria.
Source: Made by JICA Survey Team based on data from FAOSTAT.

Local rice is normally semi-milled brown rice, not-polished, with great color variation and might contain different varieties in a bag. This is due to the limited investment in processing of local rice, specifically in cleaning, de-stoning, and packaging. Imported rice is generally processed milled rice. Local rice is normally 20-30% less expensive than imported rice (USAID, 2009). Despite of the lower price of local rice, poor quality makes the local rice uncompetitive (NRDS, 2009). Consumers prefer imported rice over local rice especially in the urban area, while the reverse is the case in the rural area (NRDS, 2009). In general, consumers prefer parboiled rice whether imported or not, although the preference varies across the states. For example, non-parboiled rice is preferred in Ekiti state, while, parboiled rice is preferred in Niger state (FAO, 2013). The result of consumers' preference survey conducted in June-July, 2021 is shown below in 2.2.

The trading is dominated by imported rice compared to local rice. For example, in Nasarawa state 30-50% of produced rice is consumed locally, and the rest is shipped only to the neighboring states. In Niger state 40-60% is

[1] Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Guinea, Kenya, Liberia, Madagascar, Mozambique, Niger, Nigeria, Senegal, Sierra Leone, Togo.

consumed locally, and the rest is marketed only to the neighboring states as well (JICA, 2016).

2.2 Consumers' preference

Figure 2 shows the results of consumer preference survey carried out in June-July 2021. The number of respondents to the web-based questionnaire survey was 51 in total. In general, the people prefer the local rice, and also parboiled rice. The important factors when choosing rice are taste, price, cleanliness, swelling capacity, nutritional value, aroma and appearance. The local rice is evaluated better than the imported rice in price, taste, aroma, swelling capacity and nutritional value. Regarding the appearance and cleanliness, the imported rice is evaluated better than the local rice. The results of the consumer survey show that the local rice is positively evaluated in quality and price factors in general, but the local rice would be more competitive by improvement of post-harvest handling in terms of appearance and cleanliness.

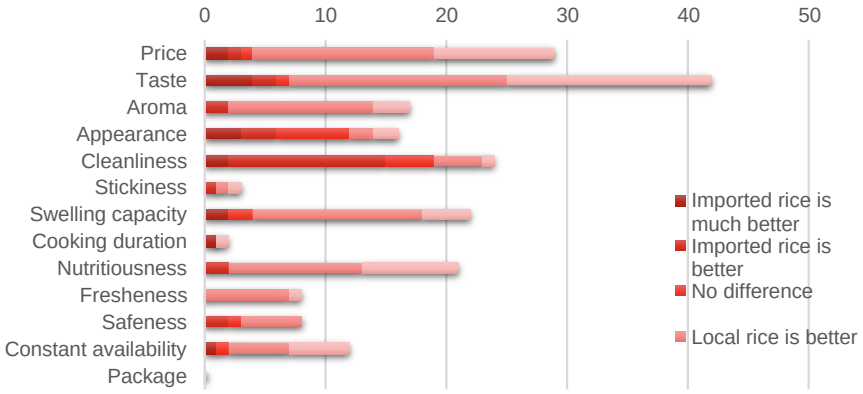


Fig. 2. Important factors when choosing rice and comparison between imported and local rice.

2.3 Major brands/varieties

(1) Local rice

Numerous rice varieties have been grown in Nigeria. Table 1 and 2 show the recommended rice varieties for lowland irrigated cultivation and upland cultivation. Among those varieties FARO 44 is one of the most distributed varieties in Nigerian rice sector (Phillip *et al.,* 2018).

Table 1. Recommended variety for lowland/irrigated cultivation

Agro-Ecological Zone	Recommended Lowland Rice Variety
Hydromorphic and inland valley swamp	FARO 44, FARO 52, FARO 31, FARO 15, FARO 28, FARO 51 FARO 62 (OFADA 1), FARO 63 (OFADA 2), FARO 60 (NERICA L19), FARO 61 (NERICA L34)
Shallow swamp and irrigated swamp	FARO 44, FARO 52, FARO 51, FARO 27, FARO 29, FARO 37, FARO 60 (NERICA L19), FARO 61 (NERICA L34)
Deep water and floating	FARO 15, CK 73, DA 29, BKN 6986 – 17, ROK 5, IR 54
Mangrove	FARO 15, ROK 5, WAR 77-3-2-2, FARO 28, IR 54

Source: Phillip *et al*., 2018.

Table 2. Recommended varieties for upland cultivation.

Agro-Ecological Zone	Recommended Upland Rice Variety
Sahel	FARO 45, FARO 46 EX-China, FARO 55 (NERICA 1)
Sudan	FARO 45, FARO 46, EX-China, FARO 38, FARO 39 FARO 55 (NERICA 1)
Northern Guinea Savanna	FARO 46, FARO 39, FARO 38, FARO 11, FARO 45 FARO 55 (NERICA 1), FARO 56 (NERICA 2) FARO 58 (NERICA 7), FARO 59 (NERICA 8), FARO 62 (OFADA 1), FARO 63 (OFADA 2)
Southern Guinea Savanna	FARO 46, FARO 48, FARO 49, FARO 43, FARO 41 FARO 55 (NERICA 1), FARO 56 (NERICA 2) FARO 58 (NERICA 7), FARO 59 (NERICA 8), FARO 62 (OFADA 1), FARO 63 (OFADA 2)
Forest	FARO 46, FARO 48, FARO 49, FARO 43, FARO 41 FARO 55 (NERICA 1), FARO 56 (NERICA 2) FARO 58 (NERICA 7), FARO 59 (NERICA 8), FARO 62 (OFADA 1), FARO 63 (OFADA 2)

Source: Phillip *et al*., 2018.

Table 3 shows the cultivar names, the original variety names, growing periods and the potential yield of major two varieties for lowland/irrigated cultivation and two for upland cultivation. Those for lowland/irrigated cultivation are FARO 44 and FARO 52 as the local cultivar names in the country. Their original variety names are SIPPI and WITA 4, respectively. The ones for upland cultivation are FARO 54 and FARO 55 as the local cultivar names, and WAB 189 and NERICA 1, respectively, as variety names. FARO 57, on the other hand, is also listed as one of the most popular varieties for upland/rain-fed ecology (Rice Taskforce team, 2021).

Table 3. Commercialized lowland rice varieties and their characteristics.

	Local cultivar name	Original variety name	Maturity (days to maturity)	Potential yield (t/ha)
Lowland/irrigated	FARO 44	SIPPI	Early (110-120)	5.0-6.0
	FARO 52	WITA 4	Late (125-130)	5.0-6.0
Upland/rain-fed	FARO 54	WAB 189	Early (100-105)	2.5-3.5
	FARO 55	NERICA 1	Early (100-105)	3.0-4.0

Source: Phillip *et al*., 2018.

In Nigeria rice is mostly cultivated without irrigation (Fig. 3). Fifty-five % is under lowland condition and 29% is in upland condition. The total area is 1,895,697 ha (Diagne *et. al*., 2013). The yield is generally higher than other Sub-Saharan African countries, and the average yield in lowland is about 3 t/ha without irrigation.

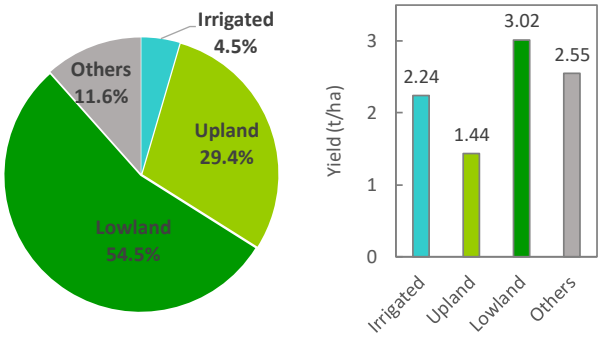


Fig. 3. Percentage of rice ecology and their average yield.
Source: Made by JICA Survey Team based on data from the study of Diagne *et al*., 2013.

The rice producing areas are wide spread in Nigeria. Table 4 shows the harvested area, quantity and yield of major producing area. The main areas are in Kaduna, Niger, Kano and Taraba states. Yield ranges are between 1.1 to 2.7 t/ha. Figure 4 shows that north west region produce 72% of local rice.

Table 4. Rice production of each state (2010/2011).

	Harvested area (ha)	Production (paddy, t)	Yield (t/ha)
Kaduna	344,890	732,420	2.12
Niger	330,670	636,670	1.93
Kano	219,060	422,050	1.93
Taraba	375,670	401,990	1.07
Benue	178,820	341,480	1.91
Ebonyi	126,080	334,850	2.66
Borno	148,270	293,420	1.98
Adamawa	77,100	187,860	2.44
Nasarawa	64,330	112,790	1.75
Gombe	56,710	105,080	1.85

Source: JICA, 2016.

Fig.4 Main rice production area.
Source: GEMS4, 2017.

Figure 5 shows the cultivation period in southern and northern area. Some farmers also utilize ratooning of harvested rice plants. Under irrigation system, rice is produced twice a year during main and off seasons.

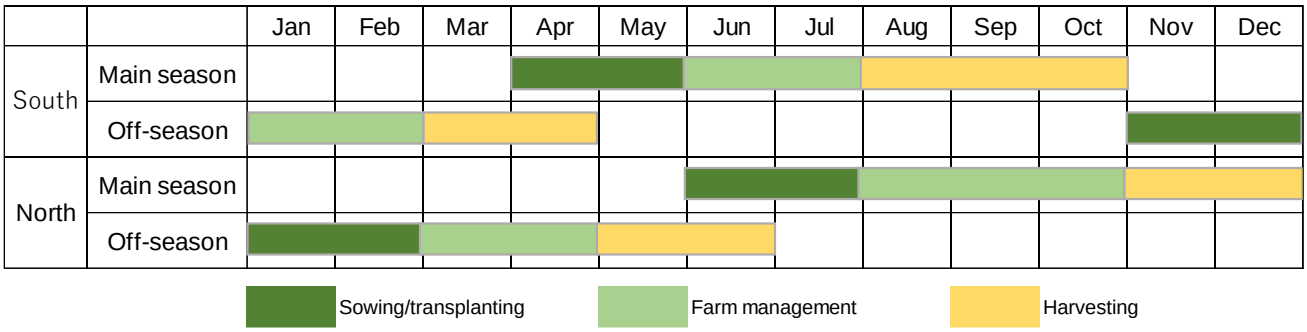


Fig. 5. Rice cultivation season in Nigeria.
Source: Made by JICA Survey Team based on the data of Rice Almanac.

(2) Imported rice

Table 5 shows the quantity and values of imported rice from major exporting countries according to UN Comtrade. The first exporting country is USA, followed by India. Rice from USA has share of 34%. We have to note that the unit value of most rice is extremely high with most of the rice, comparing to the neighboring countries. For example, the rice from Viet Nam is 3,409 USD/t, while, in case of Cameroon, the importing value of rice from Viet Nam is 379 USD/t (ITC[2], 2019). This difference is possibly due to the difference in importing quantity. The importing quantity has been decreased drastically in recent years due to that Nigerian government has been strongly controlling the rice import (Phillip *et al.*, 2018).

According to a recent market survey in 2021, the most popular imported rice in the wholesale market are recognized as rice from Thailand and India (CARD training, 2021). The most sold imported rice were 'Tomato Rice' and 'Caprice' from India, and Royal Stallion' from Thailand.

In addition to local consumption of imported rice, there is a vibrant rice trade especially in the Northern Nigeria. Nigerian traders are constantly moving rice from Niger and Cameroon in to Nigeria, and illegally re-export them to

[2] International Trade Center.

Niger and Cameroon as markets demand. The amount is small in comparison to national figure, and there are no statistical data on these volumes (USAID, 2009).

Table 5. Information about imported rice (2019).

	Quantity imported (kg)	Share in quantity (%)	Value imported (USD)	Unit Value (USD/t)
Total	**76,274**		**90,801**	**1,190**
USA	26,015	34.1	29,481	1,133
India	21,076	27.6	1,668	79
Viet Nam	12,121	15.9	41,326	3,409
Korea	10,000	13.1	13,739	1,374
South Africa	4,500	5.9	1,578	351
Thailand	1,683	2.2	262	156
China	826	1.1	1,797	2,176
Singapore	53	0.1	948	17,887

Source: UN Comtrade.

2.4 Marketing

(1) Market structure

Analyzing Nigeria's value chain is complicated because of the size of the country, the prevalence of different production system, and range of processing clusters (USAID, 2009). Figure 6 shows the structure of rice value chain of 5 channels.

Channel 1. Traditional farmers to rural village market: This channel is supplied by traditional farmers who largely produce for self-consumption, and sell the surplus to the rural village market.

Channel 2. Farmers to rural town market: This is the dominant channel, handling more than 80% of all the rice processed and marketed, with thousands of millers all over the country. There is relatively little investment made by each actors.

Channel 3. Farmers to middle-end urban market and medium-size mills: The core supply comes from millers' own production on medium to large-scale farm (20~50 ha). This is complemented by paddy from out-grower schemes. This channel has mills of between 20 and 30.

Channel 4. Farmers to large-size, industrial mills: This channel market high quality local rice, often with packaging. Main mills were Olam and Veetee (USAID, 2009). Olam has been supporting farmers with delivery of inputs, access to credit, and buy their products.

Channel 5. Imported rice channel: There are a number of major multinational corporation that dominate legal rice importation. The major distributers have well-developed systems for selling to wholesalers, though most of the sales take place in Lagos. These rice is usually packed in Thailand.

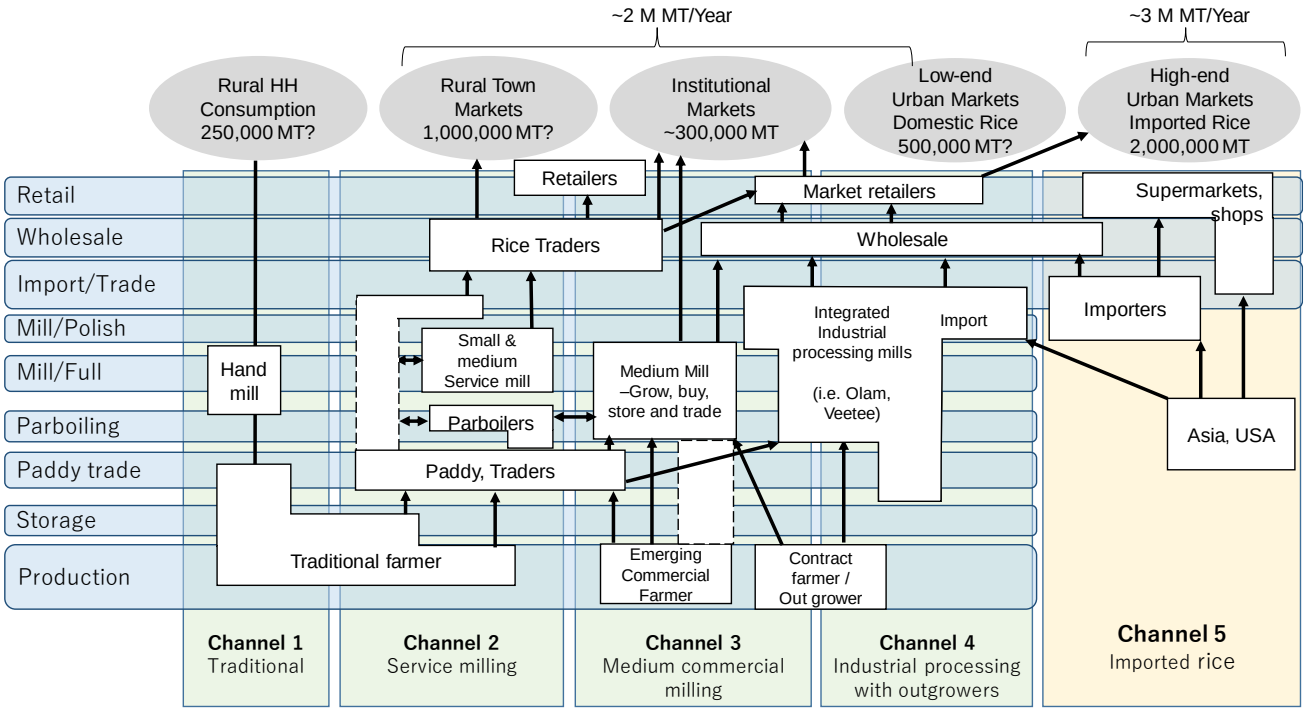


Fig. 6. Rice value chain in Nigeria.
Source: Re-made by JICA Survey Team based on USAID, 2009.

(2) Market path of local rice and imported rice

Main market path of local rice and imported rice are shown in Fig. 7. Nigeria's biggest market and sea port are in Lagos. Three other important markets are in Abuja, Kano and Ibaden. Rice is produced all over the country but the main areas are in Kaduna, Niger, Kano and Taraba state (Refer also to Table 4 and Fig. 4). As shown in Fig. 7 there are informal importation and exportation of rice between Nigeria and neighboring countries.

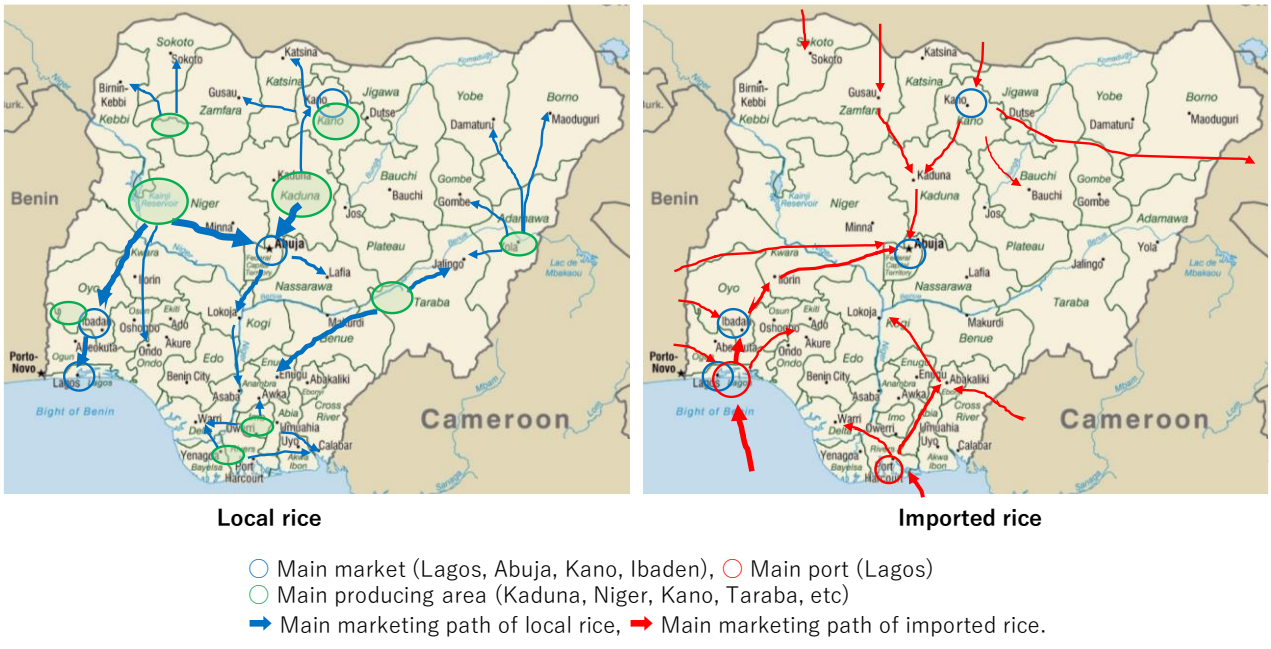


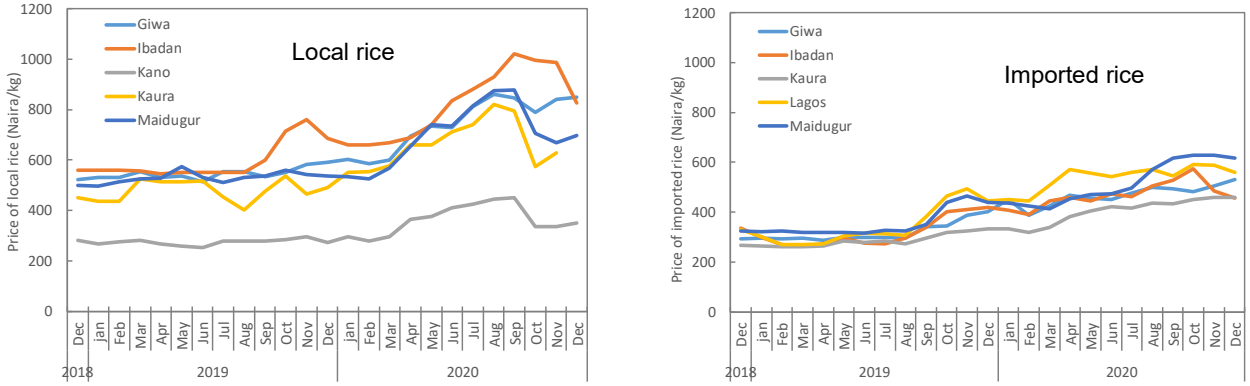
Fig. 7. Main marketing path of local rice and imported rice.

Source: The flows were drawn by JICA Survey Team, based on CARD training, 2021; Tondel *et al.*, 2020; Ugalahi, *et al.*, 2016.

2.5 Price comparison in the market

According to the data of FAO Website (FPMA Tool), local rice is more expensive than imported rice, except in the wholesale market in Kano (Fig. 8). The price of local rice was the lowest in Kano which is one of the major rice producing area.

The price information obtained from National Bureau of Statistics (2021) is shown in Table 6. They are the rice price sold loose in the market of different towns. It indicates that the local rice in the production areas (Kaduna, Niger, Kano, etc.) are cheaper than the big city like Lagos and Abuja. According to the National Bureau of Statistics, the imported rice was generally more expensive than local rice in all the markets, which is contrary to the information of FPMA Tool (Fig. 8). The reason is probably that data in Table 6 shows the average of 'high quality' imported rice.



- Kaura is within Abuja city. Maidugur = Maidugari or Maoduguri.
- Giwa is in Kaduna state.

Fig. 8. Wholesale price of local rice and imported rice (average price) in last 2 years.
Source: Made by JICA Survey Team based on the data from GIEWS FPMA Tool, FPMA Tool (fao.org), browsed March 4, 2021.

Table 6. Rice price (sold loose) of local rice and imported rice in different town in 2021 (Naira/kg).

	Rice local, sold loose	Rice imported, high quality, sold loose
Abia	440	627
Abja FTC	466	547
Anambra	406	636
Benue	388	491
Kaduna	391	552
Kano	297	492
Lagos	427	573
Nasarawa	342	489
Niger	326	399
Oyo	435	583
Plateau	377	426
River	545	670
Sokoto	313	442

Source: Made by JICA Survey Team based on the data from selected Food Price Watch of National Bureau of Statistics, 2021. Data of 13 towns out of 37 were selected.

Followings are some examples of price composition.

Table 7 is comparing margins between local rice by dominant traditional marketing channel (Channel 2 in Fig. 6) and imported rice channel (Channel 5). Fifty-four % of the retail values were comprised of trader's margin for local rice and 29% in imported rice channel.

Table 8 shows an example of price composition for local rice. Transport and agents' margin account for a considerable share.

Table 7. Margin ratio as % of retail price.

	Local rice (%)	Imported rice (%)
Retail	16	9
Wholesale trader	12	5
Initial rice trader	6	15
Initial paddy trader (grower)	19	--
Total	**54**	**29**

Source: Modified by JICA Survey Team based on FAO, 2013; USAID, 2009.

Table 8. Price composition in the value chain of local rice (Channel 2) (Naira/t, paddy).

Farmer	Production cost	45,231
	Transport	750
	Farmer margin	14,019
	Farm-gate price (paddy)	**60,000**
Rural trader	Processing cost and local market fee	4,500
	Rural market trader margin	31,500
	Rural wholesale rice price	**96,000**
Major market trader	Transport to major market	3,000
	Warehousing cost	1,000
	Major market trader margin	10,000
	Retail price	**110,000**

Source: Modified by JICA Survey Team based on FAO, 2013; USAID, 2009.

3. Competitiveness analysis

3.1 Production of local rice for DRC ratio analysis

For DRC analysis to evaluated the competitiveness of the local rice, four cases of production conditions were compared. They were;

Case I: Rain-fed, Lowland

Case II: Irrigated, Large-scale irrigation (Hadejia Jama'are River Basins Development Authority: HRBDA)

Case III: Rain-fed, Lowland, Low input (Abahaliki, Ebonya State)

Case IV: Irrigated, Intensive (Bakolori irrigation scheme)

Table 9 and 10 show the production costs and yield which were used for DRC analysis. Production data of Case I and II were provided by Rice Taskforce member. The irrigation scheme (HRBDA) is the largest functional irrigation scheme in the country, and located in Kano State. Production costs of Case III and IV are based on the survey of about 100 farmers (Egbodion and Ahmadu, 2015; Takeshima and Adesugba, 2014). The survey of both Case III and IV were conducted in 2014. The Bakolori irrigation scheme (Case IV) is in Zamfara State. Comparing Case III and IV, Case III has much lower production cost than Case IV. The labor cost is particularly high in Case IV.

Table 9. Production costs and yield under different conditions (Case I and II).

			Case I			Case II		
			Rainfed, lowland			Large-scale irrigation scheme [a]		
			Yield (t/ha): 4.00			Yield (t/ha): 5.00		
Items	Unit value (₦)	Unit	Quantity	Cost (₦/ha)	%	Quantity	Cost (₦/ha)	%
Production cost								
Hired labor	2,000	man-day	25	50,000	14	25	50,000	6
Family labor	2,000	man-day	5	10,000	3	5	10,000	1
Seeds	400	kg	50	20,000	6	50	20,000	3
Fertilizer	9,500	50 kg	400	76,000	22	400	76,000	10
Agro-chemicals	2,850	L	7	19,950	6	7	19,950	3
Water usage fee	170	L	0	0	0	300	51,000	6
Tractor service (Land preparation)	45,000	ha	1	45,000	13	1	45,000	6
Harvest	35,000	ha	1	35,000	10	1	35,000	4
Thrashing	25,000	ha	1	25,000	7	1	25,000	3
Bagging	18,000	ha	1	18,000	5	1	18,000	2
Land rent	25,000	ha	1	25,000	7	1	25,000	3
Transport	12,000	ha	1	12,000	3	1	12,000	2
Capital interest [b]				17,115	5		17,115	2
Total production cost (Naira/ha)				**353,065**			**404,065**	
Total production cost (Naira/kg, milled rice [c])				**136**			**124**	
Irrigation development [d]								
Construction				0	0		**196,423**	25
O & M				0	0		**196,423**	25
Total irrigation cost (Naira/ha)				**0**			**392,846**	
Total irrigation cost (Naira/kg, milled rice)				**0**			**121**	
Total cost (Naira/ha)				**353,065**			**796,911**	
Total cost (Naira/kg, milled rice)				**135.79**			**245.20**	

Source: Rice Taskforce member, 2021.
a) The Hadejia Jama'are river basins development authority (HRBDA).
b) Capital interest was estimated for the expenses on material inputs and 40% of labor inputs by applying 10% of annual interest rate.
c) Conversion rate from paddy grain to milled rice of 0.65 is used for the calculation as Kikuchi *et al.* (2016).
d) Irrigation development cost: The unit hardware cost of 'success' projects in sub-Saharan region (3,552 USD/ha in 2000 price) from Inocencio *et al*., (2007) was converted to the year of production cost data by GDP deflator, and multiplied by 0.01, assuming the interest rate is 10%. This is applied to both annual construction cost and O & M cost.

Table 10. Production costs and yield under different conditions (Case III and IV).

Case III			**Case IV**		
Rainfed, lowland			**Largel-scale irrigation**		
Abakaliki, Ebonya State			Bakolori irrigation scheme [c]		
Yield (t/ha): 2.20			Yield (t/ha): 5.40		
Items	Cost (₦/ha)	%	Items	Cost (₦/ha)	%
Production cost			**Production cost**		
Labor	5,198	7	Labor	133,341	19
Seeds	3,697	5	Seeds	14,745	2
Fertilizer	7,739	10	Fertilizer	48199	7
Herbicide	1,761	2	Chemicals	6183	1
Transportation	1,697	2	Machinery service	31,869	5
Land rent	15,000	20	Irrigation charge	12,367	2
Depreciation of fixed inputs	551	1	Sack	7,135	1
Capital interest [a]	1,528	2	Subleasing fee	1,268	0
			Other costs (interests, fuels)	476	0
			Total production cost (Naira/ha)	**255,582**	
			Irrigation development [d]		
			Construction	**90,249**	21
			O & M	**90,249**	21
			Total irrigation cost (Naira/ha)	**180,499**	
Total cost (Naira/ha)	**37,169**		**Total cost (Naira/ha)**	**436,080**	
Total cost (Naira/kg, milled) [b]	**25.99**		**Total cost (Naira/kg, milled)**	**124.24**	
Source: Egbodion and Ahmadu, 2015. (modified by JICA Survey Team)			Takeshima and Adesugba. 2014. (modified by JICA Survey Team)		
About 100 rice farmers were surveyed.			110 farmers were interviewed.		

Source: Egbodion and Ahmadu (2015); Takeshima and Adesugba (2014).
a) Capital interest was estimated for the expenses on material inputs and 40% of labor inputs by applying 10% of annual interest rate.
b) Conversion rate from paddy grain to milled rice of 0.65 is used for the calculation as Kikuchi *et al.* (2016).
c) Bakolori irrigation scheme is one of the largest schemes in Nigeria, and irrigation area exceeds 5,000 ha.
d) Irrigation development cost: The unit hardware cost of 'success' projects in sub-Saharan region (3,552 USD/ha in 2000 price) from Inocencio *et al*., (2007) was converted to the year of production cost data by GDP deflator, and multiplied by 0.01, assuming the interest rate is 10%. This is applied to both annual construction cost and O & M cost.

3.2 Marketing cost for DRC ratio analysis

Table 11 shows the marketing cost of local rice and imported rice used for DRC analysis. Marketing costs (post-harvest costs of local rice) is from farm-gate in Niger State to the wholesale market in Lagos (539 km) and marketing cost of imported rice is from Apapa port to wholesale in Lagos

Table 11. Marketing costs of local rice and imported rice for DRC analysis.

Marketing cost of local rice

	% farm-gate price	Cost (Naira/t, paddy)
Farm-gate price (2019) [a]		**339,600**
Processing cost and local market fee	7.5	25,470
Local market trader margin	43.0	146,028
Transport to major market [b]	20.0	67,920
Warehousing costs	2.0	6,792
Major market trader margin	7.0	23,772
Total post-harvest cost (% farm-gate)	**80.0**	
Total post-harvest cost (Naira/t, paddy)		**269,982**
Total post-harvest cost (Naira/kg, milled) [c]		**415**

Marketing cost of imported rice

	% CIF price	Cost (Naira/t, milled)
CIF price at the border [d]		**367,383**
Shipping agency charges	3.0	11,021
Cleaning charges	0.5	1,837
Transportation [e]	8.0	29,391
Initial trader margin	20.0	73,477
Wholesale trader margin	5.0	18,369
Other costs	2.0	7,348
Total access cost (% CIF)	**38.5**	
Total access cost (Naira/t, milled)		**141,422**
Total access cost (Naira/kg, milled)		**141**

Source: Modified by JICA Survey Team based on FAO-MAFAP, 2013 and USAID, 2009.
a) Farm-gate price is from "producer price (2019) from FAOSTAT (browsed on May 18, 2021).
b) Transport cost from Niger State to Lagos (539 km).
c) Conversion rate from paddy grain to milled rice of 0.65 was adopted (Kikuchi *et al.*, 2016).
d) Average CIF price of imported rice in 2019 (ITC, browsed on April 21, 2021).
e) Transport cost from Apapa port to wholesale market in Lagos.

3.3 Competitiveness analysis by DRC ratio

(1) DRC ratio analysis

In this survey, we use DRC (domestic resource cost) ratio as an indicator for the competitiveness of local rice. This measures the comparative advantage of local rice production at the capital's wholesale market, where local rice and imported rice are sold side by side (Kikuchi *et al.,* 2016). The DRC ratio is the cost-benefit ratio between the cost of domestic resources used to produce one unit of rice and the net foreign exchange that can be earned by exporting one unit of rice. We use 'tradable-good component ratio' and 'domestic-resource component ratio' of each cost needed for production and marketing of rice. Domestic rice production has a comparative advantage if DRC ratio < 1.0. Regarding the exchange rate of the currency, due to the lack of precise information on the shadow price, the market exchange rate was used to calculate the prices according to the corresponding year for conversion of foreign currency into local currency. The tradable-good component ratio refers to Kikuchi *et al.* (2016).

Table 12 shows the results of the DRC analysis. It also shows the DRC ratio without irrigation construction cost and O&M cost. The data source of production costs, irrigation costs, marketing costs for local rice and marketing cost for imported rice are shown in Table 9, 10, and 11. As shown in these tables, cost information are from different sources and from different years. The data set of production costs of Case I and II were provided by Rice Taskforce member, Ministry of Agriculture, and those of Case III and IV are from literature reviews, which are the results of on-farm survey of 100 – 110 farmers. The detailed calculation results of the DRC ratio are shown in the attached table (after the reference list).

As described before, the popular rice varieties grown in Nigeria are FARO 44 (SIPPI) and FARO 52 (WITA 4) for lowland irrigated environment, and FARO 54 (WAD 189) and FARO 55 (NERICA 1) for upland rain-fed condition. The majority of Case IV cultivated FARO 44 (41%) and another local variety called Bijin Bira (37%) (Takeshima and Adesugba, 2014). For Case III the variety that farmers were growing was not indicated in the original survey report. In 2019 the imported rice was mainly from Viet Nam (45%) and from USA (32%) (Table 5), and the average CIF price of all imported rice price (1,197 USD/t) was used for the analysis.

When calculated including costs of construction and management of irrigation infrastructure, both DRC ratio under irrigation (Case II and IV) were higher than 1.0, but lower than 2.0 (Table 12). This is due to their high productivity

between 5.0-5.4 t/ha. The DRC ratio of Case IV with intensive management in Bakolori irrigation scheme was 1.11 with fairy good competitiveness against imported rice. Case II in large-scale irrigation area had DRC ratio of about 1.6. When calculated excluding costs of construction and management of irrigation infrastructure, the DRC ratios become around 1.0.

In Nigeria some farmers practice double cropping system under irrigation (Fig. 5). Therefore, DRC ratio analysis with double cropping cultivation was conducted with Case II, where the DRC ratio was 1.64, to improve the competitiveness. When it is assumed that the yield in the second seasons is equivalent with the same level of farm inputs, the DRC ratio of Case II changes to 1.35 from 1.64. It is because the cost of irrigation structure per unit area becomes half in the calculation. This indicates the advantage of double cropping in increasing the competitiveness, but it is not significant enough to make the DRC ratio 1.0.

With rain-fed condition, DRC ratio was around 1.0, but Case I indicated the ratio slightly higher than 1.0. Farming practice in Case I requires less production cost per area, but higher cost per paddy grain than Case II because of lower yield (4.0 t/ha) (Table 9).

These results suggest that domestically produced rice under rain-fed condition, typically FARO 55 (NERIA 1), has competitiveness against imported rice. Rice under irrigated condition, typically FARO 44 (SIPPI) has competitiveness when the cost of irrigation infrastructure is treated as a sunk cost. Even with the cost for irrigation infrastructure, the competitiveness is at the level with possibility for improvement.

We have to note that, in all cases, import tariffs are not included in the calculation in this analysis since the DRC ratio analysis in principle is to evaluate the competitiveness of local rice without government intervention. Therefore, including tariffs would improve the competitiveness of local rice in all cases.

Table 12. Result of DRC analysis.

Case	Production condition	Yield (t/ha)	DRC ratio (DRC without irrigation cost [a])
I	Rain-fed / Lowland	4.0	1.15
II	Irrigated / Large-scale irrigation (HRBDA)	5.0	1.64 (1.11)
III	Rain-fed / Lowland, low input (Abakaliki, Ebonya State)	2.2	0.79
IV	Irrigated / Intensive management (Bakolori irrigation scheme)	5.4	1.11 (0.93)

a) Irrigation infrastructure cost is the sum of construction cost and O&M cost (10% of the infrastructure unit cost). The detail information is shown in Table 9 and 10 (the production cost table).

(2) Sensitivity analysis

Since the DRC ratio of rain-fed rice cultivation (Case I and III), and that of irrigated rice without irrigation development costs are about 1.0 or lower than 1.0, sensitivity analysis is not conducted for these cases. To sustain the competitiveness of local rice under irrigation, the irrigation infrastructure needs to be maintained well with proper management and then no need to construct any new infrastructure.

4. Related policy

4.1 Policy measure to stimulate consumption of local rice

NRDS (2009) shows that the government implemented zero tariff on agricultural machinery and equipment, large domestic market for rice products and bye-products, 25% subsidy on fertilizers, 50% Government subsidy on seeds,

40% aggregate subsidy on tractors and implement, and Guaranteed Minimum Price support. Moreover, the credit system has also received a boost by the Government's establishment of rice processing credit schemes at 4% interest rate and 15 years pay-back period for increased national rice processing capacity. In 2011, the government introduced the "Agricultural Transformation Agenda" (ATA), which regards agriculture as a business and encourages private investment (Sato, 2014). Under ATA, regulatory reforms on seeds and fertilizers, increased subsidies, marketing development, and tax incentives to encourage entry into the agricultural sector were implemented (Ito, 2018).

The Central Bank of Nigeria (CBN) established Anchor Borrowers Program (ABP) in 2015, which aims to create economic linkage between smallholder farmers and reputable large-scale processors to increasing agricultural output and significantly improving capacity utilization of processors (Central Bank of Nigeria, 2016).

In March 2021, the government highlighted its partnership with local and Chinese investors on irrigation farming to enhance rice production in Kano state and the ministry of agriculture indicated that Kano state has released the operation of 21 dams to a local company to support rice irrigation farming (USDA, 2021).

In recent years the government has severely restricted imports by policy measures. Imported rice faces a 10 % duty and an additional 60 % levy totaling 70 % tariff, furthermore importers are prohibited to ship rice to any Nigerian port (USDA, 2021).

Due to the neighbor country's situation, Benin's low tariff on rice import, it is led to the creation of a route for cheap rice imported to Benin and then illegally exported to the Nigerian market (Bouët, 2019). In August 2019, the government blocked imports of rice from neighboring countries Benin, Niger, and Cameroon (Bouët, 2019), but reopened its border with Benin at the end of 2020 (USDA, 2021). The government's decision to close its border did not stop the unofficial route of rice trade. In 2021, there is a bill at the House of Representative calling for an outright ban on rice import is being proposed.

4.2 Quality standards and status of the application

In October 2017, the Standard Organization of Nigeria (SON) published a paddy grading standard and adapted the Paddy Grading Manual and Paddy Quality Checking Manual developed by JICA with the Federal Ministry of Agriculture and Rural Development (FMARD) (JICA, 2018). The Manual on Simple Paddy Quality Checking in the Fields/Storages of Farmers/Traders indicates the specific requirement for grading (FMARD and JICA, 2016 b) (Table 13). These are explained visually and very useful tool for the stakeholders.

Table 13. Specific requirement for rice grading.

No.	Characteristics		Grade 1	Grade 2	Grade 3	Test Method
1	Purity, % m/m (weight basis.)		**Minimum Limits**			ISO 605
			98	95	95	
			Maximum Limits			
2	Foreign matter, % m/m	Organic (empty shell +other organic.)	1.0	1.5	2.0	
		Inorganic	0.3	0.3	0.5	
3	Pest damaged grains, % m/m, max		0.5	0.8	1.0	
4	Decolored grains, % m/m, max		0.5	2.0	4.0	
5	Moisture, % m/m, max		14.0	14.0	14.0	ISO 711; ISO 712
6	Immature/shriveled grains, % m/m		1.0	3.0	5.0	ISO 605
Paddy can be categorized into wholly long, medium, and short grain.						

Source: Made by JICA Survey Team based on FMARD and JICA, 2016 b.

The project of Rice Post-Harvest Processing and Marketing Pilot Project in Nasarawa and Niger States (RIPMAPP) prepared the grading standard for parboiled milled rice as shown in the Fig. 9, and it can be used by parboiled milled rice processors/traders as a common scale (FMARD and JICA, 2016 a).

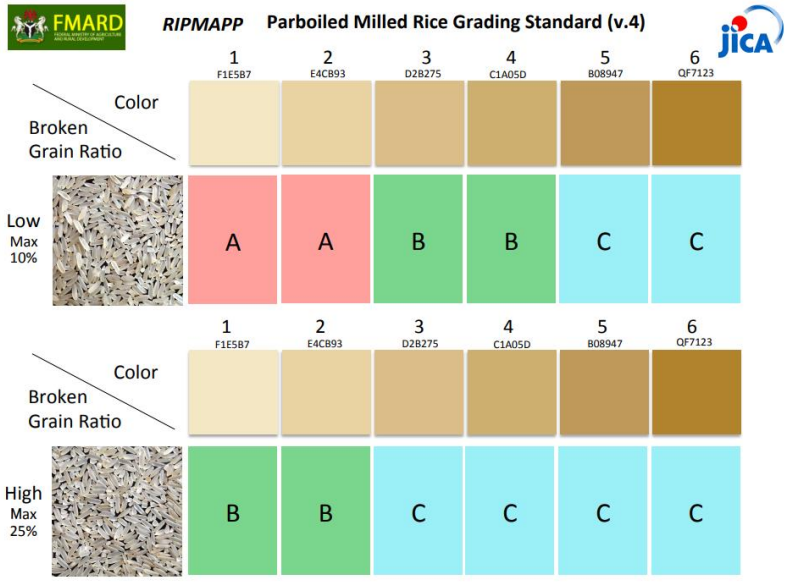


Fig. 9. RIPMAPP Grading Standard for parboiled milled rice.
Source: FMARD and JICA, 2016 a.

5. Main issues and suggestions

Nigeria is the largest rice producing country in Africa, but it used to be the second largest rice importer in the world. In recent years, rice production has been catching up with the increasing demand, and the self-sufficiency rate has been sustained high (84 – 99%). Seventy-two % of local rice is produced in North West region and the yield is relatively high comparing to other Sub-Saran African countries. Irrigated area is only 4.5%, and some farmers are practicing double cropping. The local rice is well evaluated by consumers for price and taste, but not for the appearance nor cleanliness. This indicates that there is needs to improve the post-harvest handling. According to FAO database, local rice is generally more expensive than imported rice in the markets. The national statistics service indicates when compared with high quality imported rice, the local rice is cheaper. The rice market structure for local rice is diverse and well developed. For imported rice, the government has been regulating rice import through the ports, which resulted in the illegal imports and exports especially in the Northern regions.

The results of DRC ratio analysis suggested that, rain-fed rice cultivation, which accounts for 95% of local rice production, has comparative advantage against imported rice. For irrigated cultivation, even when including the irrigation infrastructure cost, the degree of non-competitiveness is not very serious with DRC ratio of 1.1 - 1.6, mainly due to the high yield. Under the large-irrigation scheme (HRBDA), when irrigation infrastructure cost was treated as a sunk cost, the ratio was lowered to 1.1. Considering double cropping farming in the DRC ratio calculation, the ratio becomes low but not enough to make the DRC ratio 1.0. This means the large-scale irrigation needs to be maintained well to use longer time instead of constructing new schemes, in order to sustain the competitiveness of local rice.

References

Bouët, A., D. Labord, and S. Malhotra. 2019. Walk the Talk: Nigeria's import prohibitions, smuggling, and the African Continental Free Trade Agreement, International Food Policy Research Institute. https://www.ifpri.org/blog/walk-talk-nigerias-import-prohibitions-smuggling-and-african-continental-free-trade-greement#:~:text=In%202004%2C%20Nigeria%20prohibited%20of%20rice%20imports%20from,exchange

%20to%20import%20food%20commodities%20such%20as%20rice, browsed in June 29, 2021.

CARD Training. 2021. Inception report for CARD Training, Nigeria.

Central Bank of Nigeria. 2016. Anchor Borrowers' Programme Guidelines

Diagne, A., E. Amovin-Assagba, K. Futakuchi, and M.C.S. Woperisis. 2013. Estimation of cultivated area, number of farming households and yield for major rice-growing environments in Africa. *In* Realizing Africa's rice promise. Africa Rice Center, p35-45.

Egbodion, J., and J. Ahmadu. 2015. Production cost efficiency and profitability of Abakaliki rice in Ihialia local government area of Anamra state, Nigeria. J. Appl. Sci. Environ. Manage. Aol.19: 327-333.

FAO-MAFAP. 2013. Analysis of incentives and disincentives for rice in Nigeria. MAFAP Technical Note.

FAOSTAT. http://www.fao.org/faostat/en/#data/FBS, browsed on April 4, 2012.

FMARD and JICA. 2016 a. A Guideline for RIPMAPP Technology Dissemination.

FMARD and JICA. 2016 b. Manual on Simple Paddy Quality Checking in the Fields/Storages of Farmers/Traders.

GIEWS FPMA Tool, https://fpma.apps.fao.org/giews/food-prices/tool/public/#/home, browsed on March 4, 2021.

ITC (International Trade Center), https://www.trademap.org/, browsed on April 12, 2021.

Inocencio, A., M. Kikuchi, M. Tonosaki, A. Maruyama, D. Merry, H. Sally, and I. de Jong. 2007. Costs and performance of irrigation projects: A comparoson of sub-Saharan Africa and other developing regions. IWMI Research Report 109. International Water Management Institute, Colombo, Sri Lanka.

Ito, N. 2018. Project research material, Issue 8, Chapter 5 Africa, Policy Research Institute, Ministry of Agriculture, Forestry and Fisheries (農林水産政策研究所プロジェクト研究資料 第 5 章アフリカ -コメの需給と関連政策-) *In Japanese.*

JICA. 2016. Rice post-harvest processing and marketing pilot project in Nasarawa and Niger states. Final report.

JICA. 2018. Standards Organization of Nigeria Published the Paddy Grading Standard and Adopts the Paddy Grading Manual and Paddy Quality Checking Manual developed by JICA and FMARD, https://www.jica.go.jp/nigeria/english/office/topics/180214.html, browsed in June 27, 2021,

Kikuchi, M., Y. Haneishi, A. Maruyama, K. Tokida, G. Asea, and T. Tsuboi. 2016. The competitiveness of domestic rice production in East Africa: A domestic resource cost approach in Uganda. J. Agr. Rural Develop. Trop. Subtrop. Vol.17: 57-72.

National Rice Development Strategy (NRDS). 2009. Federal Republic of Nigeria.

National Bureau of Statistics (NBS), 2021. Selected food price watch, February 2021.

Phillip, D. O.O. Jayeoba, Y. Ndirpaya, and F. Oluwole. 2018. Innovation opportunities in the rice value chain in Nigeria. FARA Research Report. Vol.2: p.48.

Rice Almanac, 4th edition. 2013. http://books.irri.org/9789712203008_content.pdf , browsed in March, 2021.

Rice Taskforce member. 2021. Personal communication.

Sato, J. 2014. Nigeria's Political Economy-Potential for Agribusiness-, JETRO (ナイジェリアの政治経済事情～農業ビジネスの可能性～) *In Japanese.*

Takeshima, H, and M. Adesugba. 2014. Irrigation potential in Nigeria. IFPRI Discussion Paper 01399, IFPRI.

Tondel, F., C. D'Alessandro, I. Hathie, and C. Blancher. 2020. Rice trade and value chain development in West Africa: An approach for more coherent policies. IPAR. Discussion Paper No. 283.

Ugalahi, U.B., S.O.Adeoye, and M.U. Agbonlahor. 2016. Irrigation potentials and rice self-sufficiency in Nigeria: A review. African J. Agric. Res. Vol.11: 298-309.

UN Comtrade. https://comtrade.un.org/data/, browsed on June 22, 2021.

USAID. 2009. Global food security response Nigeria rice study. microREPORT #159.

USDA. 2021. Grain and Feed Annual, Nigeria, 2021.

GMS4. 2017. Mapping of rice production cluster in Nigeria. Coffey, Abuja, Nigeria.

Attached Table: Calculation and result of DRC ratio analysis

With irrigation infrastructure cost

	LOCAL PRODUCTION											IMPORT			DRC CALCULATION		
		Production cost				Irrigation cost		Marketing cost Farm-gate to market		Total		Border price	Marketing cost Border to market		Total cost		DRC ratio
	Paddy yield	Total	Total	Production								(CIF price of 367 ₦/kg) [a]					
		(/ha)	(/kg milled rice)	Tradable	Domestic	Tradable	Domestic	Tradable	Domestic	Tradable	Domestic		Tradable	Domestic	Tradable	Domestic	
Production conditions										$Sa_i P_i SER$ (①)	$Sb_j P_j$ (②)	$P_w SER$ (③)	$S_k c_k P_k SER$ (④)	$S_m d_m P_m$ (⑤)	$A = ① - ④$	$B = ② - ⑤$	$B / (③ - A)$
	t/ha	₦/ha	---------- ₦/kg of milled rice ----------														
Case I: Rainfed, Lowland	4.00	353,065	135.79	43.20	92.60	0.00	0.00	65.31	350.05	108.50	442.65	367.38	19.47	121.97	89.03	320.68	**1.15**
Case II: Irrigated, small-scale farm	5.00	404,065	124.33	34.56	89.77	48.35	72.53	65.31	350.05	148.22	512.34	367.38	19.47	121.97	128.74	390.37	**1.64**
Case III: Rainfed, lowland, low input (Abakaliki, Ebonya State)	2.20	37,169	25.99	5.63	20.36	0.00	0.00	65.31	350.05	70.94	370.41	367.38	19.47	121.97	51.47	248.44	**0.79**
Case IV: Irrigated, intensive (Bakolori irrigation scheme)	5.40	255,582	72.82	19.95	52.86	20.57	30.85	65.31	350.05	105.83	433.76	367.38	19.47	121.97	86.36	311.79	**1.11**

Without irrigation infrastructure cost

	LOCAL PRODUCTION											IMPORT			DRC CALCULATION		
		Production cost				Irrigation cost		Marketing cost Farm-gate to market		Total		Border price	Marketing cost Border to market		Total cost		DRC ratio
	Paddy yield	Total	Total	Production								(CIF price of 367 ₦/kg) [a]					
		(/ha)	(/kg milled rice)	Tradable	Domestic	Tradable	Domestic	Tradable	Domestic	Tradable	Domestic		Tradable	Domestic	Tradable	Domestic	
Production conditions										$Sa_i P_i SER$ (①)	$Sb_j P_j$ (②)	$P_w SER$ (③)	$S_k c_k P_k SER$ (④)	$S_m d_m P_m$ (⑤)	$A = ① - ④$	$B = ② - ⑤$	$B / (③ - A)$
	t/ha	₦/ha	---------- ₦/kg of milled rice ----------														
Case I: Rainfed, Lowland	4.00	353,065	135.79	43.20	92.60			65.31	350.05	108.50	442.65	367.38	19.47	121.97	89.03	320.68	**1.15**
Case II: Irrigated, small-scale farm	5.00	404,065	124.33	34.56	89.77			65.31	350.05	99.87	439.82	367.38	19.47	121.97	80.39	317.85	**1.11**
Case III: Rainfed, lowland, low input (Abakaliki, Ebonya State)	2.20	37,169	25.99	5.63	20.36			65.31	350.05	70.94	370.41	367.38	19.47	121.97	51.47	248.44	**0.79**
Case IV: Irrigated, intensive (Bakolori irrigation scheme)	5.40	255,582	72.82	19.95	52.86			65.31	350.05	85.26	402.91	367.38	19.47	121.97	65.79	280.94	**0.93**

a) Average CIF price of imported rice in 2019 (ITC, browsed on April 21, 2021) was used for the calculation of DRC ratio.