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Rice demand and supply projection analysis in Nigeria from 2018 to 2030

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ABSTRACT
Rice is a cash crop in Nigeria that is widely grown and consumed in all geopolitical zones of the country. Rice production in Nigeria has increased over time because of increasing demand for rice, however, the increase in supply is not sufficient to match the increasing demand. This study examined rice demand and supply projection analysis in Nigeria from 2018 to 2030, projecting the aggregate demand and supply for rice in Nigeria, as well as the disaggregated demand by region for rice in Nigerian from 2018 to 2030. The result showed that the aggregate demand for rice in Nigeria was projected at 19,796,832,353 kg with a 67.35 percent projected increase for rice demand in 2030 and the population size is projected to also increase by 26.60 percent in 2030. The rice disaggregates demand across the six geopolitical zones of Nigeria also showed an increased demand in all zones, with the highest increase of 70.70 % in North central. The aggregate rice supply is projected at 8,773,617,507 kg, indicating a 56.92 percent increase for rice supply in 2030. This shows that the supply of rice in Nigeria will not be sufficient to meet the demand in the country by 2030. The study therefore recommends that the Federal Government and private sectors should strengthen efforts towards increasing domestic production of rice, by using more efficient technologies as well as strengthening agricultural research so as to boost rice production in the country.

Keywords: Aggregate demand, aggregate supply, Nigeria, projected demand, rice

RÉSUMÉ
Le riz est une culture de rente au Nigeria qui est largement cultivée et consommée dans toutes les zones géopolitiques du pays. La production de riz au Nigeria a augmenté au fil du temps en raison de l'augmentation de la demande de riz, cependant, l'augmentation de l'offre n'est pas suffisante pour répondre à la demande croissante. Cette étude a examiné l'analyse des projections de l'offre et de la demande de riz au Nigéria de 2018 à 2030, projetant la demande et l'offre globales de riz au Nigéria, ainsi que la demande désagrégée par région de riz au Nigéria de 2018 à 2030. Le résultat a montré que la demande de riz au Nigéria a été projetée à 19 796 832 353 kg avec une augmentation prévue de 67,35% de la demande de riz en 2030 et la taille de la population devrait également augmenter de 26,60% en 2030. La demande de riz désagrégée dans les six zones géopolitiques du Nigéria a également montré une augmentation de la demande dans toutes les zones, avec la plus forte augmentation de 70,70 % dans le centre-nord. L'offre globale de riz est projetée à 8 773 617 507 kg, ce qui indique une augmentation de 56,92% de l'offre de riz en 2030. Cela montre que l'offre de riz au Nigeria ne sera pas suffisante pour répondre à la demande dans le pays d'ici 2030. L'étude recommande donc que le Gouvernement fédéral et les secteurs privés devraient redoubler d'efforts pour accroître la production nationale de riz, en utilisant des technologies plus efficaces et en renforçant la recherche agricole afin de stimuler la production de riz dans le pays.

Mots-clés: Demande globale, offre globale, Nigéria, demande projetée, riz

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INTRODUCTION

Rice (*Oryza sativa)* is a staple food in Nigeria that is produced and consumed in all regions of Nigeria. With the growing population in Nigeria, rice production will be critical as it plays a key role in the provision of food and employment, as well as in enhancing farmers' income and food security (Okpe *et al*., 2018). Nigeria is the highest producer and consumer of rice in West Africa and the highest producer in Africa as well as being one of the leading importers of rice in the world (FAO, 2019). The major producing States in the country are Kebbi, Sokoto, Ogun, Ebonyi, Enugu, Anambra, Niger, and Kogi. Rice production in the country has increased from 3.3 million tons in 2000, 3.6 million tons in 2005 to 3.7 million tons in 2018, though the production has continually fallen below the demand for rice in Nigeria (FAOSTAT, 2007). The amount of land available for rice production in Nigeria was reported to be about six million hectares.

However, only 3.2 million hectares were used for rice production, producing about 3.7 million tons of rice per year, while the total demand for rice in 2018 was about 6.4 million tons (USDA, 2018). These estimates imply that the domestic production of rice is only able to meet 57.8 % of the national demand for rice. Given that the domestic demand for rice far exceeds internal supply for rice, the deficit is usually supplied through rice importation. In order to boost domestic rice production, the Government of Nigeria has initiated investment strategies and also introduced policies to restrict the importation of rice and other cereal products. Yet, with the ever-increasing Nigeria population, increased income levels, rapid urbanization and associated changes in family occupational structures, the demand for rice still exceeds the domestic supply (Akande, 2003). The United Nations (UN) has estimated the 2018 Nigerian population as 195,875,237 at an annual growth rate of 2.61%, with the per capita demand for rice calculated at 33 kg per year. In the 1960's, 1980's and late 1990's, the per capita consumption of rice in Nigeria was recorded at an average of 3 kg, 18 kg and 22 kg, respectively (Udemezue, 2018). In 2001, the per capita consumption of rice was 24.8 kg per year (Okeowo, 2016). This shows that per capita consumption for rice in Nigeria is constantly increasing, and will continue to increase with the growing population. However, if the increase in demand is not commensurate with the supply, there will be shortage in supply, which will pose great threat to food security in Nigeria. This study looks at the demand and supply projection analysis in Nigeria from 2018 to 2030, projecting the aggregate demand and supply for rice in Nigeria, as well as the disaggregated demand by region for rice in Nigeria from 2018 to 2030.

METHODOLOGY

The area of study, Nigeria, is located in West Africa. It is the most populous country in Africa with a population estimate of 195,875,237 people growing at a rate of 2.61% as at 2018 (World Bank, 2019). This increasing population implies a high demand for food.

This study analyses demand for rice encompassing both the locally produced rice and the imported rice. Secondary data were used for data analysis. Data from Food and Agriculture Organization (FAO), National Population Commission (NPC), National Bureau of Statistics (NBS), United Nations (UN), and World Bank were used.

Data analysis. The demand projection according to Kumar *et al*. (2009) was adopted for this study because it is simple to apply as it requires minimum information and fewer variable. In the study of per capita expenditure was used as a proxy for income. According to Kumar *et al* (2009), a simple formulation for the demand of a given commodity can be predicted by Equation

$$D_t = d_0 * N_t (1 + y * e)^t \quad (1)$$

Where D_t represents the total projected demand for rice in year t; do represents per capita demand for rice in the base year (2018 at t=0); N_t represents projected population in year t; y represents growth in per capita income; e represents expenditure elasticity of demand for rice and t represents time period in years.

In order to solve for the projected population in year t (N_t), a simple formulation was used as shown in equation 2.

$$(2) \quad N_t = N_0 * (g+1)^t$$

Where N_0 represents the base year (2018) population size (at t=0); g represents growth rate in population size and t remains as defined.

The country's per capital consumption of rice (do) in 2018 was estimated at 33 kg using rice consumption data from USDA (2018). Asagunla and Agbede (2018) estimated rice expenditure elasticity (e) at 2.91, while the income and price elasticity of demand was estimated using the Almost Ideal Demand Systems (AIDS) for selected food-crops in Nigeria. The growth per capita income (y) was estimated at 2.4 using World Bank (2018) data on world development indicators (World Bank, 2019). Rice demand projections were computed at an aggregate level for Nigeria as a whole and disaggregate level (by region). The disaggregated level divided Nigeria according to the six (6) Geo-political zones. The disaggregated data for population size and population growth rate at State level were retrieved from the National Population Commission (NPC) based on the 2006 census.

For the rice supply projection, equations 3 and 4 below which were adopted from Kumar et al. (2010) was used. Equation 3, measures the Supply of rice (S_t), while Equation 4 measures the Supply growth (S_g).

$$(3) \quad S_t = S_0 * (1+S_g)^t$$

$$(4) \quad Sg = Es*Pg+Ei+Pig+AREAg+TFPg$$

Where S_t represents the supply of rice in time t in metric tons

S_o Represents the base year (2018) rice production in metric tons

S_g Represents the predicted growth of rice production

E_s Represents the long-run rice output supply elasticity

P_g Represents rice output real price growth

E_i Represents the long-run fertilizer input demand elasticity

P_{ig} Represents fertilizer input real price growth

$AREA_g$ Represents growth in acreage used for rice production

TFP_g Represents growth in Total Factor Productivity

RESULTS AND DISCUSSIONS

The rice demand aggregate projection for 2018 - 2030 is shown in Table 1 .The results show that the demand for rice in Nigeria is projected at 19,796,832,353 kg, implying a 67.35 percent projected increase for rice demand in 2030. Table I also shows that the population size is projected to increase by 26.60 percent by 2030.

The rice demand disaggregate projection for 2018 - 2030 is shown in Table 2. The projected demand for rice in North East, North Central, North West, South East, South South and South West regions of Nigeria are 3,019,077,733 kg, 5,521,415,128 kg, 3,518,072,965 kg, 3,255,255,711 kg, 4,390,788,447 kg and 2,418,516,606 kg, respectively. This implies a 69.60, 69.10, 70.70, 69.10, 69.52 and 68.40 percent projected demand increase in North East, North Central, North West, South East, South South and South West, respectively, by 2030. The results of the rice disaggregate demand projection for rice, therefore shows that the demand for rice will be highest in the North Central Region of Nigeria.

The aggregate rice supply projection for Nigeria from 20 18-2030 is presented in Table 3. The projection in Table 3 shows that the supply of rice

in Nigeria is projected at 8,773,617,507 kg. The result indicates a 56.92 percent projected increase in rice supply by 2030, while the population size is projected to increase by 26.60 percent in 2030. This shows that the supply of rice (8,773,617,507 kg) will not be sufficient to meet the demand for rice (19,796,832,353 kg) by 2030. The demand for rice is 2.26 times higher than the domestic supply for rice, hence there is need to boost rice production in Nigeria in order to attain sufficient supply of rice in the country.

Table 1. Projected aggregate demand for rice in Nigeria from 2018 to 2030

Year	Base year rice demand in kg (do)	Base year population size (No)	Population growth rate (g)	Projected population size (Nt)	GDP per capital growth rate (y)	Expenditure elasticity of rice demand (e)	Projected demand for rice in kg (Dt)
2018	33	195,875,237	2.61	195,875,237	2.40	2.91	6,463,882,821
2019	33	195,875,237	2.61	200,987,581	2.40	2.91	7,095,810,260
2020	33	195,875,237	2.61	206,233,357	2.40	2.91	7,789,516,709
2021	33	195,875,237	2.61	211,616,047	2.40	2.91	8,551,041,860
2022	33	195,875,237	2.61	217,139,226	2.40	2.91	9,387,015,861
2023	33	195,875,237	2.61	222,806,560	2.40	2.91	10,304,717,040
2024	33	195,875,237	2.61	228,621,811	2.40	2.91	11,312,135,278
2025	33	195,875,237	2.61	234,588,840	2.40	2.91	12,418,041,569
2026	33	195,875,237	2.61	240,711,609	2.40	2.91	13,632,064,381
2027	33	195,875,237	2.61	246,994,182	2.40	2.91	14,964,773,492
2028	33	195,875,237	2.61	253,440,730	2.40	2.91	16,427,772,009
2029	33	195,875,237	2.61	260,055,533	2.40	2.91	18,033,797,393
2030	33	195,875,237	2.61	266,842,983	2.40	2.91	19,796,832,353

Table 2. Projected demand for rice in six regions of Nigeria from 2018 to 2030

Year	Projected demand for rice North-East region (kg)	Projected demand for rice North-West region (kg)	Projected demand for rice North-Central region (kg)	Projected demand for rice South-South region (kg)	Projected demand for rice South-West region (kg)	Projected demand for rice South-East region (kg)
2018	919,151,244	1,708,587,045	1,030,815,489	1,007,330,115	1,338,320,610	764,266,965
2019	1,014,910,134	1,884,031,747	1,141,847,033	1,110,766,889	1,477,606,167	841,273,263
2020	1,120,645,363	2,077,491,829	1,264,838,045	1,224,824,974	1,631,387,851	926,038,591
2021	1,237,396,286	2,290,817,183	1,401,076,705	1,350,595,010	1,801,174,346	1,019,344,736
2022	1,366,310,538	2,526,047,656	1,551,989,950	1,489,279,626	1,988,631,350	1,122,052,256
2023	1,508,655,317	2,785,432,556	1,719,158,413	1,642,204,947	2,195,597,919	1,235,108,419
2024	1,665,829,840	3,071,452,158	1,904,332,981	1,810,833,264	2,424,104,509	1,359,555,937
2025	1,839,379,097	3,386,841,421	2,109,453,135	1,996,777,026	2,676,392,895	1,496,542,586
2026	2,031,009,040	3,734,616,144	2,336,667,260	201,814,254	2,954,938,165	1,647,331,786
2027	2,242,603,348	4,118,101,797	2,588,355,149	2,427,905,543	3,262,473,000	1,813,314,262
2028	2,476,241,945	4,540,965,324	2,867,152,929	2,677,212,809	3,602,014,485	1,996,020,862
2029	2,734,221,446	5,007,250,207	3,175,980,669	2,952,19,965	3,976,893,711	2,197,136,682
2030	3,019,077,733	5,521,415,128	3,518,072,965	3,255,255,711	4,390,788,447	2,418,516,606

Table 3. Rice supply projections for Nigeria from 2018-2030

Year	t	S_0	E_s	P_g	E_i	P_{ig}	$AREA_g$	TFP_g	S_g	S_t
2018	0	3,780,000	0.660	0.662	-0.200	0.500	0.069	0.032	0.073	3,780,000,000
2019	1	3,780,000	0.660	0.662	-0.200	0.500	0.069	0.032	0.073	4,054,765,176
2020	2	3,780,000	0.660	0.662	-0.200	0.500	0.069	0.032	0.073	4,349,503,813
2021	3	3,780,000	0.660	0.662	-0.200	0.500	0.069	0.032	0.073	4,665,664,693
2022	4	3,780,000	0.660	0.662	-0.200	0.500	0.069	0.032	0.073	5,004,808,127
2023	5	3,780,000	0.660	0.662	-0.200	0.500	0.069	0.032	0.073	5,368,603,626
2024	6	3,780,000	0.660	0.662	-0.200	0.500	0.069	0.032	0.073	5,758,843,128
2025	7	3,780,000	0.660	0.662	-0.200	0.500	0.069	0.032	0.073	6,177,448,828
2026	8	3,780,000	0.660	0.662	-0.200	0.500	0.069	0.032	0.073	6,626,482,641
2027	9	3,780,000	0.660	0.662	-0.200	0.500	0.069	0.032	0.073	7,108,156,364
2028	10	3,780,000	0.660	0.662	-0.200	0.500	0.069	0.032	0.073	7,624,842,563
2029	11	3,780,000	0.660	0.662	-0.200	0.500	0.069	0.032	0.073	8,179,086,269
2030	12	3,780,000	0.660	0.662	-0.200	0.500	0.069	0.032	0.073	8,773,617,507

CONCLUSIONS

The projection analysis of rice demand and supply in Nigeria shows that the demand and supply for rice is increasing rapidly. However, the increase in projected rice demand is highest in North Central region and lowest in South East region. These projections results create a picture of what to expect in the future with respect to the demand for rice. Given the present domestic rice level of productions, it is clear that the supply for rice is likely not to meet the demand for rice unless the status quo changes to at least the same rate as the demand. Hence, to meet this increasing demand for rice in the country, the study recommends that the Federal Government as well as the private sectors should strengthen efforts towards increased domestic production of rice. Such efforts could be directed towards the use of more efficient technologies for rice production. This would invariably require strengthening agricultural research so that sustainable increase in rice production can be ascertained.

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STATEMENT OF NO CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this paper.

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