



GROWTH RATE, TRENDS AND FORECAST ANALYSIS OF WHEAT DEMAND-SUPPLY GAP IN NIGERIA

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ABSTRACT

The study analyzed the growth rate, trends and forecast of wheat demand-supply gap in Nigeria. The study made use of time series data spanning from 1990 to 2020. Data on the variables for the study were collected from the archives of Food and Agriculture Organization (FAO) and analyzed using both descriptive such as mean, maximum and minimum with trend graphs and inferential statistics such as Growth model and Autoregressive Integrated Moving Average (ARIMA) model. Findings of the study revealed that supply of wheat in Nigeria within the study period ranges from 32,600 tons to 169,961 tons with mean of 79609.97 tons. Wheat demand ranges between 427575 tons and 8142811 tons with a mean of 4153978 tons during the period of study. However, the demand has not been met as there is a widening demand-supply gap of 99%, indicating that demand of wheat has a higher growth rate than supply. The result further revealed a stagnating instantaneous growth rate (IGR) of 9.2% for demand and a decelerating IGR of 1.4% for supply but an accelerating IGR of 9.4% for the wheat demand-supply gap. The study also forecasted an increase in demand from 8078642.57 tons in 2021 to 10002488.59 tons in 2030 and wheat supply increase from 40306.22 tons in 2021 to 94707.54 tons in 2030. The demand-supply gap will consequently increase from 7860173.39 tons in 2021 to 9628172.33 tons in 2030. Consequently, the study recommended that Government and other players in the sub-sector should encourage the high production of wheat in the country to boost domestic supply so as to reduce the wheat demand-supply gap.

Keywords: Wheat, Demand, Supply, Gap, Growth, ARIMA.

INTRODUCTION

The agriculture sector is an important sector of the Nigerian economy, accounting for 42 percent of GDP and providing 60 percent of employment (Food and Agriculture Organization, 2018); however, the sector only represents 1 percent of exports. Nigeria has the potential to produce enough food to feed itself, lower the cost of food imports, and become a major food exporter. According to the Food and Agriculture Organization (2019), Nigeria's agriculture contribution to GDP makes it the largest sector in the country. Crop production accounts for a huge chunk of activities in the sector representing 88% of total industry size with livestock, forestry and fishing accounting for the balance of 12% (NBS, 2020). In Nigeria, the sector contributes about 55% of gainful employment and almost 42 % of the share of GDP and before the discovery of oil, this figure is as high as between 75 – 80% of the GDP. Nevertheless, this current figure for the GDP share of agriculture sector is quite high when we compared it with the average of 27% for low-income nations in Sub-Sahara Africa (World Development Indicator, 2018).

Nigeria has a comparative advantage for production of most cereal grains due to its tropical climate and vast fertile land, in exception of barley oats, and rye. Nigeria is the highest producer of maize and sorghum in Africa, with 12 and 10 million metric tons (MMT) per



annum, second highest producer of sorghum worldwide, and fifth highest producer of maize worldwide, but 13th in the highest importers of wheat worldwide, estimated at 4mmt in 2015. Its per capita wheat consumption is estimated at 20 kg in 2011 (GAIN, 2014). Wheat production is holding steady at about 100,000 tons per year (FAO, 2010), despite heavy investment by the federal government to promote this cereal.

Wheat (*Triticum Aestivum Desf.*) is an important industrial and food crop and an important raw material in the flour mills. It ranks second among the most important cereal crops in the world, after rice (Najafi, 2014). Wheat flour is used in Nigeria for bread and cake (85-99%). Semovita (1 0%), biscuit (about 4%), pasta (below 1 %), macaroni and spaghetti (below 1 %) (FAO, 2012). The offals (residues) are used in the feed-mills in compounding livestock feeds. The crop can also be processed for its starch content. Wheat contributes more calories and more protein to the world's diet than any other crop. World trade in wheat also exceeds trade in all other grains put together. Historical reports confirmed the introduction of wheat to West Africa through the Arabs. The crop gradually got into Nigeria via Sudan.

Wheat production in Nigeria was initially confined to the Chad basin, and was on a very small scale with no improved technology used and mainly made into dishes by the farmers. Since temperate varieties were mainly used, its production was confined to the cool dry season of November to March, necessitating the use of irrigation. Wheat production is relatively a new phenomenon in the farming systems of most farmers, localized in areas between latitude 1 0-14°N which has been identified by research as suitable for the crop growth. For this reason, relatively little is known about the crop (National Agricultural Extension and Research Liaison Services, 2004).

According to Global Agricultural Information Network (2014), Nigeria's wheat demand continues to rise and is attracting more third-country suppliers of inexpensive wheat. Nigeria's consumption of wheat exceeded 4 million metric tons in 2013/2014 as compared to 3.8 million metric tons the previous year (GAIN, 2014). Consumption also maintained a steady rise in 2014/2015 as consumer demand for wheat-based foods continued to climb. As Nigeria and its neighboring countries continue to demand high quality wheat-based foods usually obtained from flour derived from exclusively wheat, market analysts hold that over the next few years consumers will insist on demanding more of the higher quality, wheat flour-based products, which will cause wheat to recapture its lost market share in the next few years but imply dependence of these countries on her.

According to Abah and Ochoche (2021), wheat consumption has been increasing steadily in all African countries during the past 20 years as a result of growing population, changing food preferences and a strong urbanization trend which has led to a growing 'food gap' in all regions, largely met by imports. Nigeria is finding itself more and more caught up in "wheat trap" in which most of its foods are made from wheat (Ayo, 2010). Presently, the domestic wheat demand is far more than the local production. It is on record that 90-95% of the wheat being consumed is imported from the United States of America (Falaki and Mohammed, 2011). This is paradoxical since the country has the capacity for to be self-sufficient in wheat production. Self-sufficiency in food production is a long-term goal of many nations. Reliable estimates are imperative for policy engendering towards self-sufficiency in agricultural production.

Much emphasis has been laid by many studies such as Abah and Ochoche (2021), (Falaki and Mohammed (2011) amongst others on the dangers of dependence on imported wheat and also on the importance of wheat. However, no known studies have been made on



the analysis of the demand and supply of wheat in Nigeria. Therefore, this study shall thus seek to analyze the growth rate, trends and forecast of wheat demand and supply in Nigeria.

MATERIALS AND METHODS

The Study Area

The study area is Nigeria. Nigeria is located on the Gulf of the Guinea in West Africa with a geographical area of 923, 768 square kilometers. It is one of the eight most populous countries in the world with a population of about 140 million (NPC, 2006). With a population growth rate of 2.6%, Nigeria has an estimated population of about 210.87 million in 2021 (www.statista.com). Nigeria lies wholly within the tropics along the Gulf of Guinea on the western coast of Africa. The topography ranges from mangrove swamp land along the coast to tropical rain forest and savannah to the north. Nigeria is located between latitude 4°16' and 13°53' north and longitude 2°40' and 14°41' east (CIA Fact Book, 2009). Because Nigeria has a highly diversified agro-ecological climate, agriculture is one of the most important sectors of the Nigeria economy. The climate varies with Equatorial in South, Tropical in Centre and in the North. In the North, the vegetation is grassland savannah and, in the south, forest. Because of this vegetation, agriculture is the major employer of labour in the country. In terms of employment, at least 60% of Nigeria's projected population of 210.87 million, is estimated to be engaged or employed in agriculture (mainly small holders). Women make up to 60-80 percent of work or labour and produce two thirds of food crops.

Data Collection and Data Analysis Techniques

The study made use of secondary data. Annual time series data spanning from 1990 to 2020 were sourced from Food and Agriculture Organization (FAO) database. Data for this study were analyzed using both descriptive and inferential statistics. Specifically, descriptive statistics such as mean, maximum and minimum with trend graphs, growth model and Autoregressive Integrated Moving Average (ARIMA) model were used for analysis in the study.

Model Specification

For the growth model, the trend equation is given as:

$$Y_t = Y_0(1+r)^t \quad \dots(1)$$

where;

Y_t = Wheat demand and supply in year t .

Y_0 = Wheat demand and supply in the base year.

r = Compound rate of growth of Y ,

t = time in chronological years.

Taking the natural log of equation (1) to make it linear, it is stated thus

$$\ln Y_t = \ln Y_0 + t \ln(1+r) \quad \dots(2)$$

Substituting in $\ln Y_0$ with β_1 and $\ln(1+r)$ with β_2 , equation (2) is rewritten as

$$\ln Y_t = \beta_1 + \beta_2 t \quad \dots(3)$$

Adding the disturbance or error term to equation 3, we obtain

$$\ln Y_t = \beta_1 + \beta_2 t + U_t \quad \dots(4)$$

Equation 4 is the growth rate model developed for this study. A semi-log growth model was developed for this study instead of a linear trend model because the point of interest in this study is both absolute and relative in the parameters of interest. The most important parameter in equation 3 is the coefficient of β_2 which is the slope and measures the constant proportion or relative change in Y for a given absolute change in the value of the regressor t . multiplying β_2 by 100 gives the instantaneous growth rate at a point in time.



$$\text{IGR} = b_2 \times 100 \quad \dots(5)$$

where; IGR = Instantaneous growth rate.

where;

IGR = Instantaneous growth rate and

β = is the least-square estimate of the slope coefficient

Secondly, the compound growth rate (CGR) in percentage cases can be recovered from the equations 5 in the following manner:

$$\text{CGR} = (e^{\beta_i} - 1) \times 100 \quad \dots(6)$$

Where:

β_i = the coefficient of the trend variable in the respective cases

e= Euler's exponential constant (= 2.71828)

In order to estimate the direction or pattern of growth so as to determine whether there is acceleration, deceleration or stagnation, quadratic equation in time trend variable was fitted as follows:

$$\text{Lin} Y_t = \beta_0 + \beta_1 t_i + \beta_2 t_i^2 + U_t \quad \dots(7)$$

All variables as previously defined, β_0 , β_1 and β_2 are parameters to be estimated. In the specification of equation 7, the linear and quadratic time terms indicate the circular path in the dependent variable (Y_t). The quadratic time variable (t^2) allows for the possibility of determining whether there was acceleration, deceleration or stagnation in the study.

Finally, in equations 7, if β_2 is positive and statistically significant there is acceleration in growth, if β is negative and statistically significant there is deceleration in growth, if β is not statistically significant there is stagnation in the growth process.

The linear trend analysis model with the form $Q = b_0 + b_1 T + e$ and the quadratic model with the form $Q = b_0 + b_1 T + b_2 T_2 + e$ was also tested to determine the best fit.

RESULTS AND DISCUSSION

Trend of Wheat Demand and Supply in Nigeria (1990-2020)

The trend of wheat demand in Nigeria from 1990-2020 is presented in Figure 1. The result showed that the demand for wheat ranges between 427575 tons and 8142811 tons with a mean of 4153978 tons during the period of study. Wheat demand decreased between 1990 and 1994 but increased from 1995 till the year 2000. The demand for wheat increased progressively from the year 2000 to 2020, but within this period experienced intermittent declines from 2012 to 2015. The trend of wheat demand is generally observed to be on the rise. This could be attributed to increase in population, urbanization, changing food preferences and increase in the consumption of wheat-based food. This is in line with the result of Abah and Ochoche (2021) and Harun *et al.* (2017) who posited that urbanization, increasing population, civilization and copying of western feeding lifestyle has made wheat-based products increasingly being consumed in the country thereby increasing the demand for wheat which is a recipe for these products.

The result further showed that the supply of wheat in Nigeria within the study period ranges from 32,600 tons to 169,961 tons with mean of 79609.97 tons. The trend revealed that wheat supply in Nigeria has been quite low. This is in line with the report of CBN (2018) that the national supply of wheat has not kept pace with wheat demand over the years. Similarly, Abah and Ochoche (2021) reported that the domestic supply (production) of wheat in Nigeria between 1981 and 2018 fluctuated tremendously.

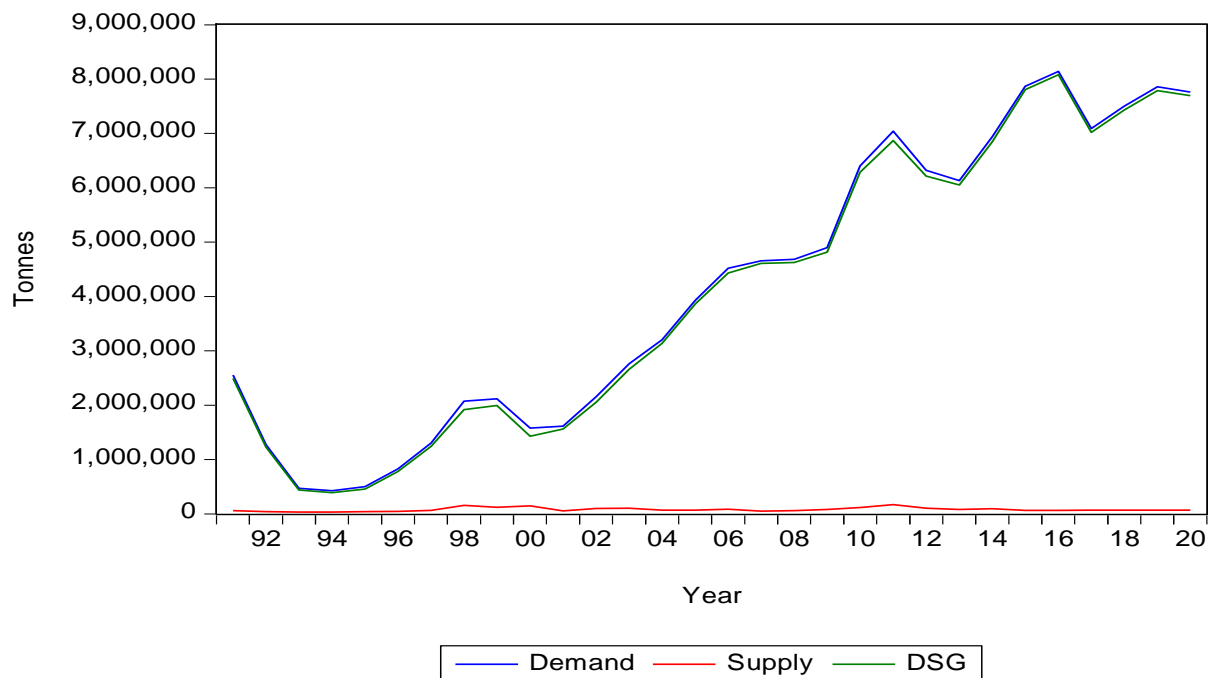


Figure 1: *Trend of Wheat Demand and Supply (1990-2020)*
Source: Data analysis, 2021.

Table 1: Summary Statistics of the Variables

Parameters	Supply	Demand	DSG
Mean	79609.97	4153978.	4074368.
Median	68224.00	4224706.	4146811.
Maximum	169961.0	8142811.	8079735.
Minimum	32600.00	427575.0	392374.0
Std. Dev.	35172.62	2668312.	2662271.
Skewness	1.015412	0.092793	0.101807
Kurtosis	3.374131	1.515441	1.512305
Jarque-Bera	5.330277	2.797946	2.818370
Probability	0.069590	0.246850	0.244342
Sum	2388299.	1.25E+08	1.22E+08
Sum Sq.Dev.	3.59E+10	2.06E+14	2.06E+14
Observations	30	30	30

Growth Rate and Direction of Wheat Demand, Supply and Demand Supply Gap in Nigeria (1990-2020)

The result of the growth model showing the growth rates and direction (pattern) of growth of wheat demand and supply is shown in Table 2. The trend equation of wheat demand revealed that the coefficient for estimating the growth (b_2) is significant at 1% probability, indicating acceleration in the growth process. The instantaneous growth rate (IGR) of wheat demand is 9.2% while the compound growth rate (CGR) is 9.6%. The coefficient of multiple determination (R^2) value of 0.79 shows that 79% of the variations in the trend of wheat demand are explained by time. Similarly, the trend equation of wheat supply revealed that the coefficient for estimating the growth b_2 is 0.014 and the t-value shows that there is deceleration

in wheat supply. The instantaneous growth rate (growth at a point) of wheat supply is 1.4%. The direction of growth of wheat supply shows that there is a decelerated growth pattern over the years. The coefficient of multiple determination (R^2) value of 0.59 shows that 59% of the variations in the trend of wheat supply are explained by time. Furthermore, the trend equation of wheat demand-supply gap revealed that the coefficient for estimating the growth b_2 is 0.094 and the t-value of 10.35 is significant at 1% probability, indicating an accelerated growth process. The instantaneous growth rate (growth at a point) of wheat demand-supply gap is 9.4% while the compound growth rate (CGR) is 9.9%. The direction of growth of wheat demand-supply gap shows that there is acceleration in wheat demand-supply gap over the years. The coefficient of multiple determination (R^2) value of 0.79 shows that 79% of the variations in the trend of wheat demand-supply gap are explained by time.

Table 2: Growth rate and direction of wheat demand, supply and demand-supply gap

Variable	Model	Determinant	Coefficient	t-stat	Prob.	R^2	F	AIC
Wheat Demand	Linear	Trend	289242.3	16.893	0.000	0.91	285.3	30.11
		Constant	-40034.91	-0.138	0.890			
	Quadratic	Trend	3459.095	2.92	0.002	0.918	152.0	30.09
		Constant	428096.0	1.06	0.300			
	Exponential	Trend	0.09	10.41	0.000	0.794	108.30	1.16
		Constant	13.59	91.05	0.000			
Wheat Supply	Linear	Trend	649.99	0.87	0.390	0.026	0.76	23.84
		Constant	70184.98	5.58	0.000			
	Quadratic	Trend	-222.34	-2.53	0.017	0.213	3.66	23.70
		Constant	39939.54	2.41	0.023			
	Exponential	Trend	0.014	1.62	0.116	0.585	2.62	1.12
		Constant	10.99	75.08	0.000			
Demand Supply Gap	Linear	Trend	288592.3	16.89	0.000	0.91	285.48	30.11
		Constant	-110219.9	-0.38	0.705			
	Quadratic	Trend	3682.58	1.72	0.096	0.92	154.28	30.07
		Constant	388156.4	0.97	0.342			
	Exponential	Trend	0.09	10.36	0.000	0.79	107.31	1.22
		Constant	13.53	87.93	0.000			

Source: Data analysis (2021)

Table 3: Demand, Supply and demand-supply gap growth rate and direction of growth

Variables	IGR (%)	CGR (%)	Direction of growth
Demand	9.2	9.6	Accelerating
Supply	1.4	1.4	Decelerating
Demand-Supply Gap	9.4	9.9	Accelerating

Note: IGR = Instantaneous growth rate; CGR = Compound growth rate

Source: Data Analysis, 2021.

Forecast of the Trend of Wheat Demand in the Next Decade (2021-2031)

Figure 2 shows the forecast of wheat demand for the next decade. The result showed that there will be an increase in demand in the next decade albeit intermittent fluctuations in the trend. Demand generally will increase from 8078642.57 tons in 2021 to 10002488.59 in 2030. The increase in wheat demand in the next decade could be explained by the increasing dependence of the country on wheat-based food, urbanization and population growth. GAIN



(2021) reported that more than half of Nigeria's population live in urban areas (urbanization is growing at a rate of 4.23 percent annually). The country has largest population of any African nation. The population, projected to grow to 392 million by 2050, will make Nigeria the world's fourth most populous country. This population is increasingly reliant on domestic and imported processed food products. Bread, semolina, and durum pastas and other wheat flour-based products are major staples in Nigeria's urban areas. Similarly, Figure 3 shows the trend of wheat demand-supply gap in the next decade. The result shows that wheat demand-supply gap will continue to widen during the next decade *ceteris paribus*.

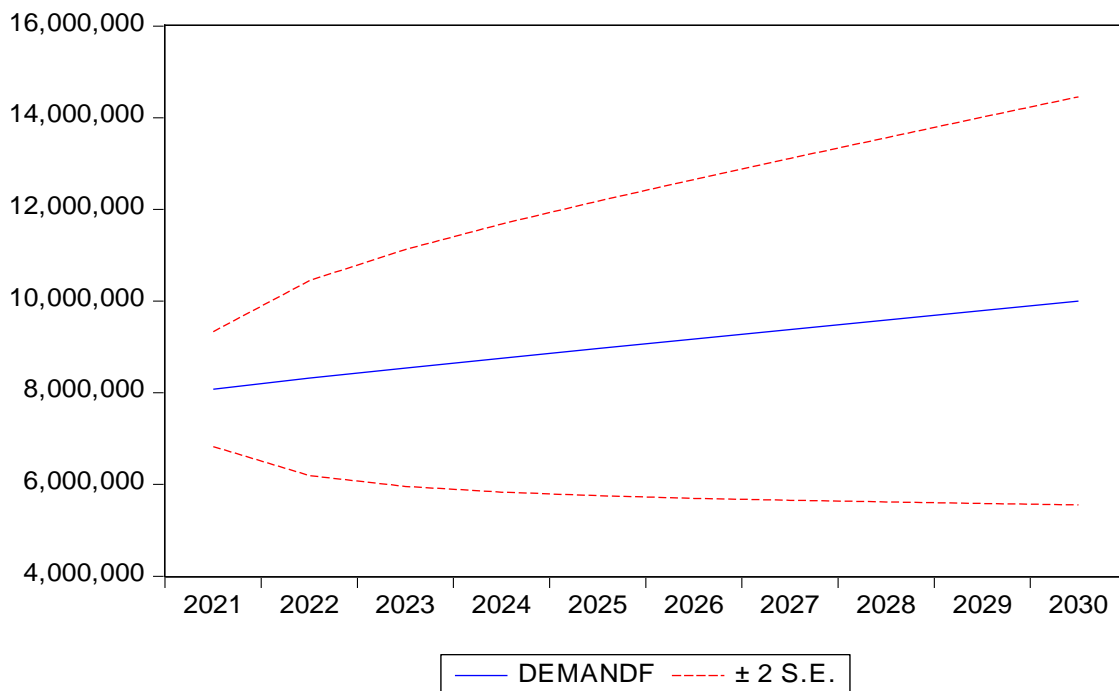


Figure 2: Forecast of Wheat Demand in Nigeria for the Next Decade

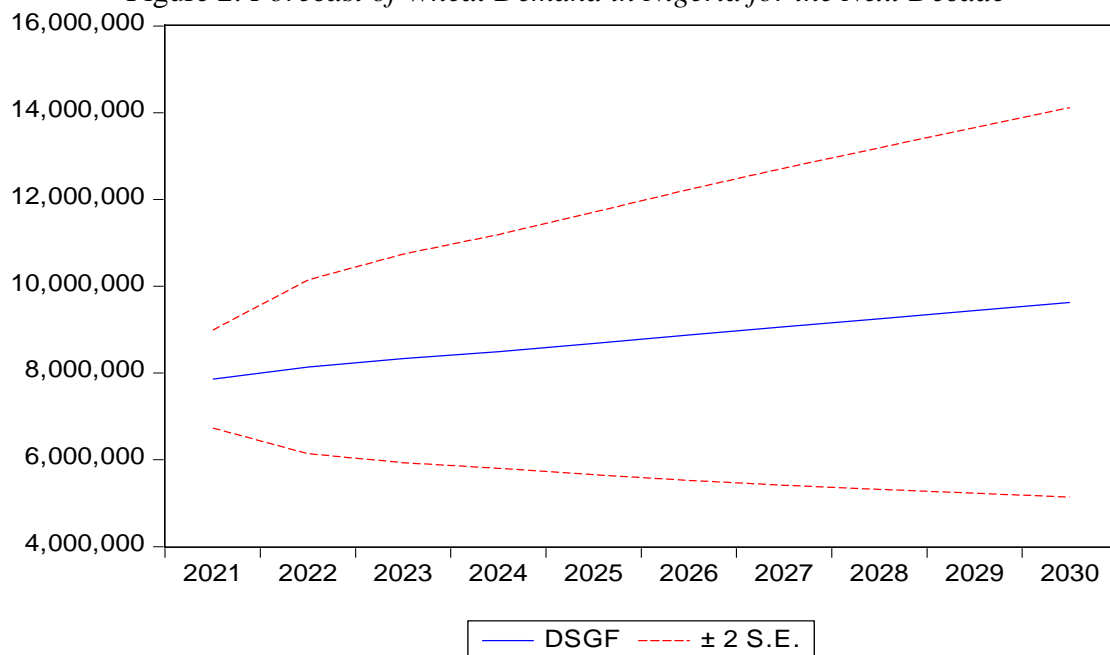


Figure 3: Forecast of Wheat Demand-supply gap in Nigeria for the Next Decade

Forecast of the Trend of Wheat Supply in the Next Decade (2021-2031)

The forecast graph of wheat supply is shown in Figure 4. The result showed that wheat supply in Nigeria will increase from 40306.22 tons in 2021 to 94707.54 in 2031. This shows that wheat supply will grow quite slowly and fairly constant in the next decade. This implies that, during the next decade, wheat supply will not be able to cater for the demand for wheat by the teeming population in Nigeria. This necessitates the need to increase local production of wheat to bridge this obvious demand-supply gap in Nigeria.

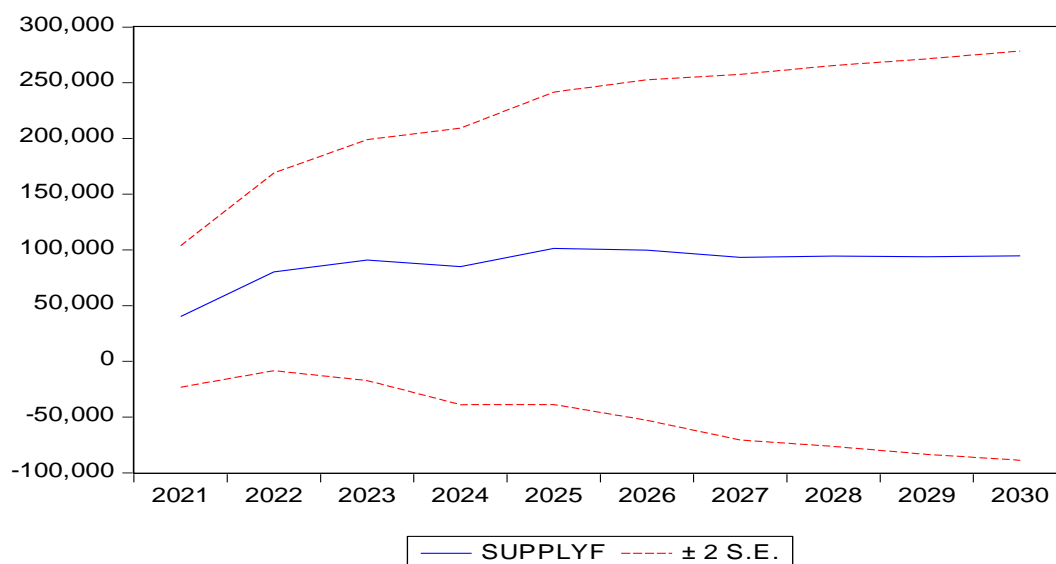


Figure 4: Forecast of Wheat Supply in Nigeria for the Next Decade

Table 4: Forecast of demand and supply for the next decade

Year	Demand	Supply	DSG
2021	8078642.57	40306.22	7860173.39
2022	8317955.21	80289.46	8139513.88
2023	8540465.18	90852.97	8334626.58
2024	8754847.15	85086.36	8493474.57
2025	8965297.33	101385.94	8679420.86
2026	9173845.57	99773.14	8877034.47
2027	9381473.79	93382.47	9065929.84
2028	9588656.96	94408.39	9251071.52
2029	9795624.84	93881.03	9439018.09
2030	10002488.59	94707.54	9628172.33

Source: Data analysis (2021)

CONCLUSION AND RECOMMENDATIONS

The study revealed that demand for wheat in Nigeria has been on a geometric increase while wheat supply has not increased proportionately thereby occasioning a wide demand-supply gap in Nigeria. A bulk of these demand for wheat has been satisfied by imports which is not ideal and sustainable for agriculture growth and development in Nigeria. The forecast of the series showed that in the next decade, wheat demand will still exceed wheat supply substantially with a huge demand-supply gap to cover. This calls for conscious and concerted efforts by all players in the sub-sector to intensify wheat production so as bridge the demand-supply of wheat in Nigeria.



The study therefore recommended that:

1. Government and other stakeholders should encourage the high production of wheat in the country, seeing the increase in the demand.
2. Farmers should be encouraged with adequate loans, grants, improved seeds and extension services to boost production of wheat in the country so as to reduce the wheat demand-supply gap.
3. Exportation of wheat from the country should be minimized to reduce the demand-supply deficit.

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