

An Assessment of Grain Food Security in Nigeria - 2006-2015

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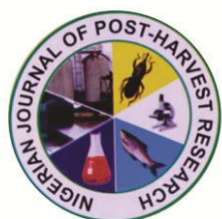
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Abstract

This study evaluated the level of grain food security in Nigeria by examining the relationships among population growth, grain production, grain imports, grain exports, and grain demand between 2006 and 2015. A quantitative ex post facto research design was adopted using secondary time-series data obtained from the World Bank, Food and Agriculture Organization (FAO), FAOSTAT, United States Department of Agriculture (USDA), National Bureau of Statistics (NBS), and World Grain publications. Descriptive statistics and Pearson Product-Moment Correlation analysis were employed to assess the relationships among the selected variables. The findings revealed that Nigeria's population increased steadily throughout the study period, while grain production failed to keep pace with rising demand. Grain production exhibited weak negative correlations with grain imports ($r = -0.40$), grain exports ($r = -0.20$), and grain demand ($r = -0.02$), whereas population growth showed a moderate positive correlation with grain imports ($r = 0.50$), indicating increasing dependence on imported grains to satisfy domestic food demand. The study concludes that sustainable grain food security requires integrated policies that increase domestic grain production, strengthen strategic grain reserves, reduce postharvest losses, promote climate-resilient agriculture, and improve food security governance and agricultural value-chain development.

Keywords: Food security, grain demand, grain import, grain production, population growth

Introduction

Food security remains one of Nigeria's most persistent development challenges despite the country's considerable agricultural potential. The Food and Agriculture Organization defines food security as a condition where all people have consistent physical, social, and economic access to sufficient, safe, and nutritious food for an active and healthy life (FAO, 2001). This concept encompasses four interconnected pillars: availability, access, utilization, and stability, with contemporary scholarship extending this framework to include dimensions of agency, sustainability, and resilience within broader socio-economic and environmental contexts (HLPE, 2020; Clapp et al., 2022). The gravity of Nigeria's food security situation is underscored by alarming statistics. The November 2024 Cadre Harmonisé analysis revealed that approximately 25.1 million people faced acute food insecurity, with over 987,000 individuals in emergency conditions. This represents a deterioration from 2023, when 18.6 million people required humanitarian assistance. Nigeria ranks 107th out of 113 countries on the Global Food Security Index and 109th out of 125 countries on the Global Hunger Index (Ibrahim et al., 2023). Food inflation remained persistently high throughout 2024, and grain prices reached extreme levels in December 2024, with local rice and wheat flour prices increasing by 112 and

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96 percent respectively on an annual basis. Several interconnected factors drive Nigeria's food insecurity. Rapid population growth, expanding at approximately 2.1 percent annually, places immense pressure on agricultural systems to meet domestic demand (World Bank, 2024). Environmental degradation, including soil erosion, nutrient depletion, and declining organic matter, has significantly reduced crop yields (Lal, 2015; Nkonya et al., 2016). Climate variability compounds these challenges; the 2024 severe floods affected approximately 1.3 million people, and projections for 2025 indicate average to below-average rainfall with a delayed rainy season in central and northern areas. Aggregate cereal production in 2024 was estimated at 28.5 million tonnes, approximately 3 percent below the five-year average. Conflict and insecurity constitute major impediments, with the Boko Haram insurgency, banditry, and communal clashes displacing approximately 3.4 million people in northern zones (Adelaja & George, 2019; George et al., 2021). Weak agricultural policy implementation and governance failures have compounded these challenges, with the National Strategic Grain Reserve system hampered by inadequate funding, poor maintenance, and weak institutional coordination (Federal Ministry of Agriculture and Rural Development, 2023).

Despite numerous studies examining individual dimensions of Nigeria's food security challenges, there exists a significant knowledge gap regarding the quantitative relationships among population growth, grain production, imports, exports, and demand over an extended period. The period 2006-2015 is particularly significant as it captures the impacts of the 2008 global food price crisis and sustained population growth prior to recent policy reforms.

This study addresses this gap by evaluating grain food security in Nigeria through examination of relationships among population growth, grain production, imports, exports, and demand between 2006 and 2015. The specific research questions are: What were the trends in these variables during the study period? What are the quantitative relationships among them? What are the implications for Nigeria's grain food security and policy formulation?

The justification for this study derives from its potential to inform evidence-based policy formulation, contribute to scholarly literature, and provide essential baseline data for assessing agricultural policy effectiveness. The scope is limited to 2006-2015, focusing on major cereal grains using secondary data

from reputable international databases analyzed through descriptive statistics and correlation analysis.

Factors affecting food security in Nigeria

According to FAO (2010), food insecurity refers to the consequences of inadequate supply and consumption of nutritious food, considering the physiological use of food by the body as being within the domain of nutrition and health. Food and Agriculture Organization of the United Nations (FAO), International Fund for Agricultural Development (IFAD), United Nations Children's Fund (UNICEF), World Food Programme (WFP), and World Health Organization (WHO) (2023) reported that Nigeria's food insecurity has persisted over the past four decades due to a combination of factors, including declining investment in agriculture following the oil boom of the 1970s and the implementation of neo-liberal economic reforms under the Structural Adjustment Programme (SAP), such as currency devaluation, trade liberalization, and reduced government intervention in the economy. Political, ethnic and religious conflicts, disasters such as flooding and drought have also contributed immensely to food insecurity (Otaha, 2013). Other factors which are greatly affecting food security in Nigeria include:

Population growth

The term 'population', as defined by the American Heritage Dictionary and cited by Abdulrahman (2012) is referred to as the total number of inhabitants constituting a particular race, class or group in a specified area. Population growth rate according to Mundi Index (2012) is the average annual percentage change in population, which is affected by birth and death as well as the balance of the number of people that are coming and leaving a particular domain within a specified period of time. Hence, the rate of population growth is adversely affecting food adequacy in Nigeria.

Population growth is a critical determinant of food security because it influences food demand, pressure on natural resources, and the capacity of agricultural systems to meet consumption needs. According to the demographic transition theory, population growth is primarily driven by the interaction of fertility, mortality, and migration patterns, with fertility remaining the dominant contributor to population increase in many developing countries (Bongaarts, 2009).

Nigeria has experienced sustained population growth over the past several decades, making it the most

populous country in Africa. The population increased from approximately 140 million in 2006 to over 178 million in 2014 (National Bureau of Statistics [NBS], 2015), while recent World Bank estimates indicate an annual population growth rate of about 2.1% in 2024 (World Bank, 2024). This rapid population expansion has significant implications for food availability and accessibility because food production has not consistently kept pace with the increasing demand for staple crops.

Empirical demographic studies attribute Nigeria's rapid population growth primarily to persistently high fertility rates, declining mortality resulting from improvements in healthcare and child survival, and a youthful population age structure that sustains population momentum (Bongaarts, 2009; United Nations, 2022). Although migration contributes to population dynamics, natural increase (the excess of births over deaths) accounts for the overwhelming majority of Nigeria's population growth (United Nations, 2022).

Several studies have demonstrated that rapid population growth exerts substantial pressure on agricultural land, water resources, food supply systems, and rural livelihoods. Jayne et al. (2014), in a multi-country African study, reported that increasing rural population density significantly reduces farm sizes and agricultural productivity, thereby constraining household food security. Similarly, Searchinger et al. (2019) argued that meeting future food demand in rapidly growing populations requires substantial improvements in agricultural productivity, reduction of postharvest losses, and sustainable land management. In Nigeria, empirical evidence suggests that population growth has outpaced the growth in domestic food production, resulting in increasing dependence on food imports, rising food prices, and greater vulnerability to food insecurity, particularly among low-income households (FAO et al., 2023).

Therefore, sustained population growth remains one of the major demographic factors influencing Nigeria's food security. Addressing its implications requires policies that simultaneously improve agricultural productivity, strengthen food supply chains, reduce postharvest losses, and enhance rural livelihoods to ensure that food production keeps pace with the country's growing population.

Environment/land availability

Environmental conditions and land availability are fundamental determinants of agricultural productivity and food security because they directly influence crop

growth, yield, and the sustainability of farming systems. Food production depends not only on the quantity of arable land available but also on soil quality, climatic conditions, land management practices, and secure access to land. Historically, farming systems in sub-Saharan Africa, including Nigeria, were adapted to prevailing environmental conditions. Traditional practices such as shifting cultivation and bush fallowing were widely adopted to restore soil fertility under conditions of low population density and abundant land resources (Jayne et al., 2014).

However, rapid population growth, urbanization, and agricultural expansion have significantly increased pressure on Nigeria's land resources. The conversion of forests and grasslands to agricultural and residential uses has accelerated land degradation, resulting in soil erosion, declining soil fertility, deforestation, desertification, and loss of biodiversity. According to the Food and Agriculture Organization (FAO, 2021), approximately one-third of the world's soils are moderately to highly degraded, while land degradation continues to reduce agricultural productivity in many developing countries, including Nigeria.

Empirical studies have shown that land degradation has become one of the principal constraints to agricultural production in Nigeria. Lal (2015) reported that soil erosion, nutrient depletion, and declining organic matter significantly reduce crop yields and threaten long-term food production. Similarly, Nkonya et al. (2016) estimated that land degradation imposes substantial economic costs on African countries through reduced agricultural productivity, declining ecosystem services, and increased rural poverty.

Land tenure insecurity further limits agricultural productivity and food security. In many parts of Nigeria, farmers operate under customary land tenure systems that often provide uncertain or undocumented land rights. Such insecurity discourages long-term investments in soil conservation, irrigation infrastructure, tree planting, and other sustainable land management practices (Place, 2009). Studies have consistently shown that secure land tenure encourages farmers to adopt improved technologies and conservation measures that enhance productivity and environmental sustainability (Lawry et al., 2017).

The quality of arable land also varies considerably across Nigeria's agroecological zones. Large areas in the northern region are increasingly threatened by desertification and recurrent drought, while severe gully erosion affects parts of southeastern Nigeria. In the southwest, topographical constraints, soil acidity,

and poorly drained clay soils reduce agricultural potential in some locations. Conversely, sandy soils with low organic matter and poor nutrient-holding capacity require substantial fertilizer and organic amendments to sustain crop production. Although soil fertility can be improved through appropriate agronomic practices, limited access to fertilizers, inadequate extension services, and low adoption of sustainable land management technologies continue to constrain productivity among smallholder farmers (Lal, 2015; FAO, 2021).

Overall, environmental degradation, declining land quality, and insecure land tenure remain significant barriers to achieving sustainable agricultural production and food security in Nigeria. Addressing these challenges requires integrated land-use planning, restoration of degraded lands, promotion of climate-smart agriculture, strengthening of land tenure systems, and wider adoption of sustainable soil management practices.

Postharvest practices

Postharvest practices comprise all operations carried out from the time crops are harvested until they are consumed or processed. For grain and cereal crops, these operations typically include harvesting, threshing, cleaning, winnowing, drying, transportation, storage, processing, packaging, and marketing. Effective postharvest management preserves grain quality, minimizes quantitative and qualitative losses, maintains nutritional value, and enhances food availability, thereby contributing significantly to food security (Affognon et al., 2015).

Primary postharvest processing involves cleaning, grading, drying, shelling, hulling, milling, tempering, soaking, parboiling, and sieving to prepare grains for storage or further processing. Secondary processing includes activities such as cooking, baking, frying, roasting, fermentation, extrusion, blending, packaging, and value addition for consumer markets. Efficient execution of these operations reduces losses, improves market value, and extends the shelf life of agricultural products.

Despite advances in postharvest technologies, postharvest losses remain a major challenge to food security in Nigeria. These losses arise from inadequate harvesting techniques, poor drying practices, insect and rodent infestation, fungal contamination, inadequate storage infrastructure, weak transportation systems, and limited access to modern processing equipment. The Food and Agriculture Organization estimates that approximately one-third of all food

produced globally is either lost or wasted before consumption, with developing countries experiencing the greatest losses during postharvest handling and storage (FAO, 2019).

Empirical studies indicate that postharvest losses in Nigeria remain substantial across major food crops. Ahungwa & Ahungwa (2020) reported average losses of approximately 13–15% for maize, 7–10% for rice, 10–20% for sorghum, while yam losses may exceed 40% under poor storage conditions. These losses substantially reduce the volume of food available for consumption, lower farmers' incomes, increase market prices, and threaten national food security.

Recent evidence further demonstrates the relationship between postharvest losses and household food insecurity in Nigeria. Adeagbo et al. (2026) found that nearly 40% of Nigerian households experience food insecurity and that households affected by postharvest losses incur higher food expenditures while exhibiting lower dietary diversity. The study further identified household head characteristics, educational attainment, agroecological zone, temperature variability, and rainfall patterns as significant determinants of postharvest losses. Similarly, Affognon et al. (2015) concluded that reducing postharvest losses through improved storage technologies, better market infrastructure, farmer education, and efficient supply chains represents one of the most cost-effective strategies for improving food availability and strengthening food security in sub-Saharan Africa.

Consequently, reducing postharvest losses should constitute a major component of Nigeria's food security strategy. Investments in modern storage facilities, hermetic storage technologies, improved transportation networks, mechanized processing, extension services, and farmer capacity building would substantially reduce food losses, improve agricultural productivity, and enhance national food security.

Poverty and agricultural productivity

Poverty remains one of the principal drivers of food insecurity in developing countries because it constrains farmers' capacity to invest in productive agricultural technologies, improve farm management practices, and adopt innovations that enhance crop yields. Agricultural production is both labour-intensive and capital-intensive, requiring access to quality inputs such as improved seeds, fertilizers, agrochemicals, irrigation facilities, mechanization, and extension services. However, the majority of Nigeria's food is produced by smallholder farmers, who account for

over 80% of the country's agricultural output but often operate under conditions of severe resource constraints (World Bank, 2008; FAO et al., 2023).

The low-income status of many rural households limits their ability to purchase modern farm inputs, hire labour, or acquire mechanized equipment, thereby reducing agricultural productivity and reinforcing the cycle of poverty and food insecurity. Empirical evidence indicates that poor farming households are less likely to adopt productivity-enhancing technologies because of limited access to credit, inadequate extension services, insecure land tenure, and weak market linkages (Jayne et al., 2019). Consequently, poverty not only reduces agricultural output but also limits household food access and dietary quality, thereby exacerbating hunger and malnutrition (FAO et al., 2023).

Macroeconomic policies have also influenced agricultural productivity in Nigeria. The implementation of structural adjustment and market liberalization policies, including currency devaluation and reduced government intervention, increased the prices of imported agricultural inputs such as fertilizers, agrochemicals, farm machinery, and improved seeds. These rising production costs disproportionately affected smallholder farmers, many of whom were unable to afford essential inputs, thereby limiting productivity growth and food production (World Bank, 2008; Otaha, 2013).

Recent evidence further demonstrates the vulnerability of rural households to economic and environmental shocks. The Agricultural Landscape Analysis Report (2024) found that approximately 68% of Nigerian households adopted no coping strategy when confronted with shocks such as climate-related events, rising food prices, or income losses. The report further revealed that rural livelihoods remain heavily dependent on low-input, rain-fed agriculture characterized by poor infrastructure, weak transportation networks, inadequate communication facilities, and limited access to markets. These structural constraints isolate farmers from profitable markets, increase postharvest losses, and reduce farm incomes.

Moreover, low agricultural productivity, coupled with poor market access, limits farmers' bargaining power and their ability to obtain remunerative prices for their produce. As a result, many smallholder farmers receive relatively low returns on investment despite providing the bulk of Nigeria's domestic food supply. This persistent combination of low productivity, inadequate infrastructure, market inefficiencies, and widespread

rural poverty continues to undermine food availability, accessibility, and overall food security in Nigeria (World Bank, 2008; FAO et al., 2023; Agricultural Landscape Analysis Report, 2024).

Insecurity and conflicts

Conflict and insecurity constitute major constraints to agricultural production and food security in Nigeria. Violent conflicts disrupt farming activities by displacing rural populations, restricting access to farmlands, destroying agricultural infrastructure, and interrupting food supply chains. These disruptions reduce agricultural output, increase food prices, and undermine the livelihoods of farming households, particularly those dependent on rain-fed agriculture (FAO et al., 2023).

In Nigeria, the protracted insurgency by the Boko Haram terrorist group and other armed conflicts in the North-East and North-West have had severe consequences for agricultural production. Large areas of arable land have become inaccessible due to insecurity, while thousands of farmers have abandoned cultivation because of attacks, kidnappings, and destruction of farming communities. The resulting displacement of rural populations has significantly reduced the production of major staple crops, including maize, sorghum, millet, rice, wheat, groundnut, onions, tomatoes, and pepper, which are predominantly cultivated in northern Nigeria (International Food Policy Research Institute [IFPRI], 2023).

Empirical evidence indicates that conflict-affected households experience significantly lower crop yields, reduced farm incomes, and increased levels of food insecurity than households in peaceful regions. A study by George et al. (2021) found that violent conflict substantially reduces agricultural productivity through labour shortages, loss of productive assets, and restricted market access. Similarly, Adelaja & George (2019) demonstrated that terrorist activities in northern Nigeria have significantly reduced agricultural output and increased poverty among rural households.

According to the Food and Agriculture Organization (FAO et al., 2023), conflict remains one of the leading drivers of acute food insecurity globally, particularly in countries where agriculture serves as the primary source of livelihood. In Nigeria, conflict has disrupted food production systems, displaced millions of people, and weakened local food markets, thereby exacerbating hunger and malnutrition. These findings are consistent with earlier observations by Ojo & Adebayo (2012) and Emeokechukwu et al. (2014),

who reported that persistent insecurity discourages agricultural investment and threatens national food security.

Consequently, improving food security in Nigeria requires not only increased agricultural investment but also sustained efforts to restore peace, strengthen rural security, rehabilitate conflict-affected farming communities, and protect farmers' access to productive resources. Enhancing security in agricultural zones would encourage cultivation, facilitate market access, increase food production, and improve the resilience of the national food system.

Climate change

Climate variability and climate change have emerged as major threats to agricultural productivity and food security in Nigeria. According to Akinkuolie et al. (2025), recurrent droughts and declining rainfall in northern Nigeria, coupled with excessive rainfall and frequent flooding across the southern and Middle Belt regions, have significantly reduced agricultural productivity and intensified food insecurity. These climate-induced hazards disrupt planting and harvesting calendars, damage farmlands and rural infrastructure, reduce crop yields, increase postharvest losses, and threaten the livelihoods of millions of farming households that depend largely on rain-fed agriculture.

One of the most significant manifestations of climate variability in northern Nigeria is the increasing frequency and severity of droughts. Prolonged dry spells, delayed onset of rainfall, and early cessation of the rainy season have reduced soil moisture availability, shortened growing periods, and increased the risk of crop failure, particularly for staple cereals such as maize, millet, sorghum, and wheat. These conditions are especially severe in the Sudan and Sahel savannah agroecological zones, where rainfall variability is naturally high and irrigation infrastructure remains limited (Intergovernmental Panel on Climate Change [IPCC], 2022). Empirical studies indicate that drought episodes have become more frequent over the last three decades, resulting in declining agricultural productivity and increasing dependence on food imports and humanitarian assistance (Sultan & Gaetani, 2016).

Conversely, southern Nigeria and parts of the Middle Belt increasingly experience extreme rainfall events and devastating floods. Seasonal flooding destroys standing crops, washes away fertile topsoil, damages irrigation facilities and rural roads, and interrupts the transportation of agricultural produce to markets. The

widespread flooding experienced in Nigeria in 2012, 2022, and subsequent years resulted in extensive losses of cultivated land, displacement of farming communities, and significant reductions in national food production. According to the Food and Agriculture Organization (FAO et al., 2023), flooding has become one of the leading climate-related drivers of food insecurity in West Africa because it simultaneously affects production, storage, transportation, and market access.

Increasing temperatures and heat stress also pose substantial challenges to agricultural production. Rising temperatures accelerate crop evapotranspiration, increase soil moisture deficits, reduce water-use efficiency, and adversely affect critical physiological processes such as flowering, pollination, and grain filling. Heat stress has been shown to reduce grain yield, grain quality, and overall crop productivity, particularly for temperature-sensitive crops such as maize, rice, and wheat. Livestock production is similarly affected through reduced feed intake, lower reproductive performance, increased disease incidence, and declining milk and meat production (IPCC, 2022).

Climate variability has also increased interannual yield variability across Nigeria. Variations in rainfall distribution, temperature extremes, and the increased occurrence of droughts and floods have made agricultural production increasingly unpredictable. As a result, farmers face considerable uncertainty regarding planting dates, crop selection, expected yields, and income generation. This variability discourages investment in agriculture, increases production risks, and reduces the resilience of rural livelihoods. Wheeler & von Braun (2013) observed that climate-induced yield variability is becoming one of the greatest challenges to global food security because unstable production leads to fluctuations in food availability, rising food prices, and increased vulnerability of poor households.

Furthermore, climate change indirectly exacerbates food insecurity by increasing the prevalence of crop pests, weeds, and plant diseases. Warmer temperatures and changing rainfall patterns have expanded the geographical distribution of destructive pests such as the fall armyworm (*Spodoptera frugiperda*), while higher humidity promotes fungal diseases and mycotoxin contamination during storage. These factors not only reduce agricultural productivity but also compromise food quality and safety.

Overall, the cumulative effects of recurrent droughts, flooding, heat stress, and increasing yield variability

have significantly weakened Nigeria's agricultural production systems and heightened the country's vulnerability to food insecurity. Building resilience will require substantial investment in climate-smart agriculture, irrigation development, drought-tolerant and flood-resistant crop varieties, improved weather forecasting services, sustainable land and water management, and comprehensive agricultural insurance schemes to reduce farmers' exposure to climate-related risks.

Methodology

Study design

This study adopted a quantitative, *ex post facto* research design using secondary time-series data to evaluate the level of grain food security in Nigeria. An *ex post facto* design was considered appropriate because the study relied on historical data that had already been collected and published by recognized national and international organizations without any manipulation of the variables. The study focused on assessing the relationships among selected grain food security indicators over a ten-year period (2006–2015).

Data sources

The study utilized secondary data obtained from reputable national and international databases. Population statistics were obtained from the World Bank World Development Indicators and publications of the National Bureau of Statistics (NBS). Data on grain production, imports, exports, and food demand were sourced from the Food and Agriculture Organization (FAO), FAOSTAT database, the United States Department of Agriculture (USDA) Grain and Feed Annual Reports, World Grain publications, and relevant government reports.

These organizations were selected because they provide standardized, internationally recognized agricultural and demographic statistics that are widely used for food security research and policy formulation.

Variables considered

Five major indicators of grain food security were selected for the analysis based on their relevance in assessing national food availability and demand.

- **Population growth (millions):** Annual population estimates representing potential food demand.
- **Grain production (tonnes):** Total annual domestic production of major cereal crops including rice, maize, wheat, millet, sorghum, and soybean.

- **Grain imports (tonnes):** Annual quantity of grains imported into Nigeria.
- **Grain exports (tonnes):** Annual quantity of grains exported from Nigeria.
- **Grain demand (tonnes):** Estimated annual national demand for grains based on domestic consumption requirements.

These variables were selected because they collectively represent the major components influencing food availability and national grain security.

Data analysis

Descriptive statistical techniques were first employed to summarize the data collected for each variable over the study period. Graphical illustrations were subsequently developed to demonstrate temporal trends and relationships among the selected variables. To determine the degree of association between the selected food security indicators, the Pearson Product-Moment Correlation Coefficient (r) was employed. Pearson correlation is appropriate for measuring the strength and direction of the linear relationship between two continuous variables.

The following variable pairs were investigated:

- Population growth versus grain production;
- Grain production versus grain imports;
- Population growth versus grain imports;
- Grain production versus grain exports; and
- Grain production versus grain demand.

Results and Discussions

To ascertain the effects of the investigated parameters in relation to grain security, relationships between pairs of these parameters were determined and the following results were obtained. Figures 1- 5 showed the relationship between the variables examined with their respective correlation equations and coefficients of determination (R^2).

The analysis obtained from the plot in Figure 1 gives correlation coefficients of -0.3, and the correlation equation is described in Equation (1).

$$Y = -0.0000002x^6 - 0.0002x^2 + 0.1019x^4 - 22.476x^3 + 2785x^2 - 183750x + 5000000 \dots\dots\dots 1$$

Figure 2 shows the plot of grain import against production where the correlation coefficient obtain is - 0.4 and the correlation equation is described in Equation 2.

$$Y = -0.2621x^6 + 35.284x^5 - 1975.9x^4 + 589226x^3 - 987031x^2 + 9000000x - 3000000 \dots\dots\dots 2$$

Figure 3 also shows the plot of grain import against population growth, the correlation coefficient obtain is 0.5 and the correlation equation is described in Equation 3.

$$Y = -0.0000008x^6 + 0.0008x^5 - 0.3267x^4 + 71.567x^3 - 6x^2 + 576408x - 20000000 \dots\dots\dots 3$$

Figure 4 as well shows plot of grain export against production where the correlation coefficient obtain is – 0.2 and the correlation equation obtain is described in Equation 4.

$$Y = -0.0364x^6 + 4.895x^5 - 274.03x^4 + 8169.8x^3 - 13681x^2 + 1000000x - 5000000 \dots\dots\dots 4$$

Figure 5 shows plot of grain production against demand where the correlation coefficient obtain is – 0.02 and the correlation equation obtain as well is described in Equation 5.

$$Y = -0.0225x^6 + 2.8819x^5 - 153.6x^4 + 4354.4x^3 - 69254x^2 + 585888x - 2000000 \dots\dots\dots 5$$

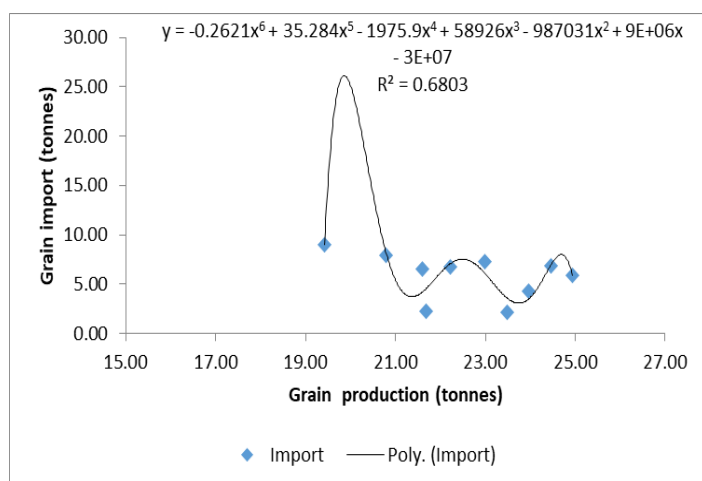


Figure 1: Grain Production versus Population

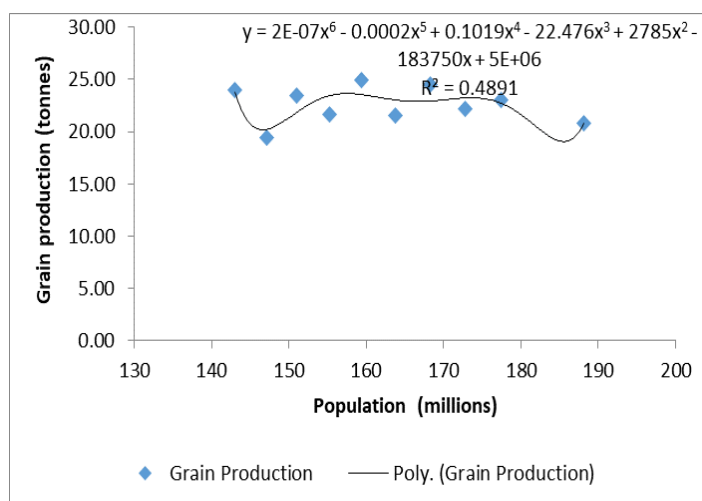


Figure 2: Grain Import versus Production

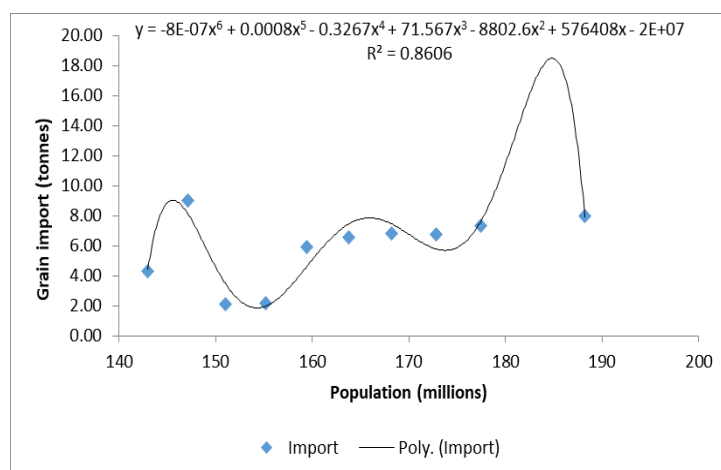


Figure 3: Grain Import versus Population Growth

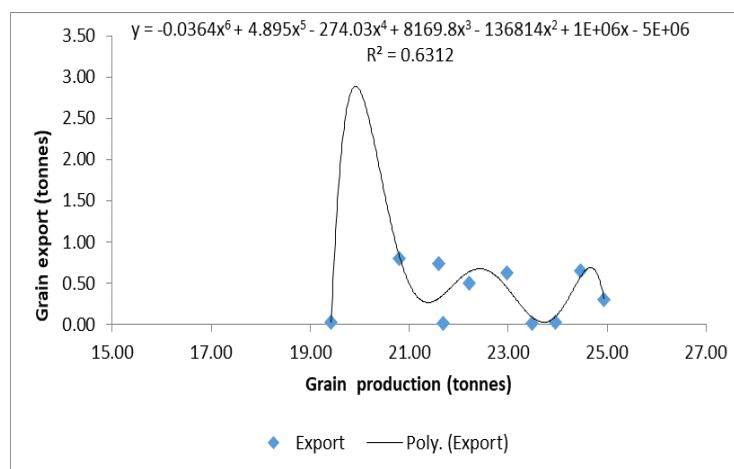


Figure 4: Grain Export versus Production

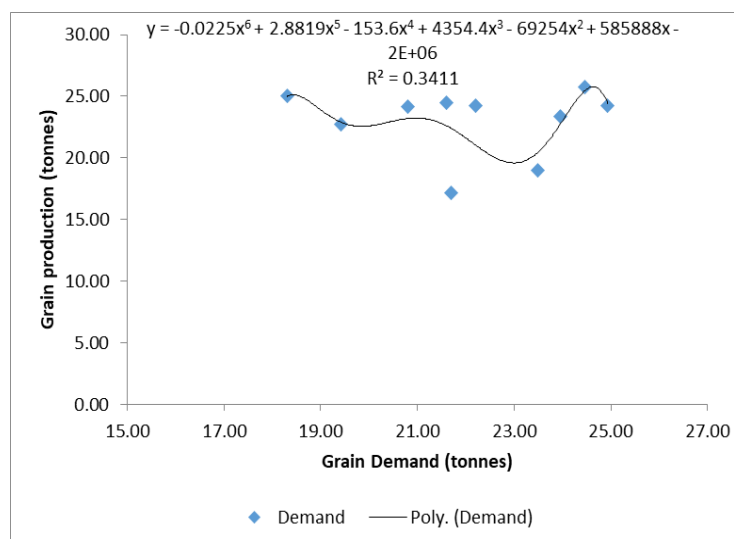


Figure 5: Grain Production versus Demand

This study evaluated the relationships among selected grain food security indicators in Nigeria, namely; population growth, grain production, grain imports, grain exports and grain demand, over the period 2006–2015. The findings revealed that Nigeria's population increased steadily throughout the study period,

whereas grain production fluctuated and generally failed to keep pace with the increasing demand for food (World Bank, 2016). This disparity indicates that domestic grain production has become insufficient to meet the food requirements of the country's rapidly expanding population, thereby increasing the risk of food insecurity and dependence on imported grains.

Correlation analysis demonstrated a weak negative relationship between grain production and grain imports, suggesting that increases in grain imports generally coincided with declining domestic production. This trend reflects Nigeria's increasing dependence on imported grains, particularly rice and wheat, to bridge the widening gap between domestic production and national demand (USDA, 2014). Furthermore, a moderate positive correlation ($r = 0.50$) was observed between population growth and grain imports, indicating that grain importation has increased alongside population growth (World Bank, 2014). These findings suggest that domestic agricultural production has not expanded sufficiently to satisfy rising consumption requirements, reinforcing the need for greater investment in agricultural productivity and value-chain development (FAO, 2014).

The study also found weak relationships between grain production and both grain exports and grain demand. Declining grain production limited export capacity while simultaneously failing to satisfy increasing domestic demand. Consequently, Nigeria has become increasingly reliant on imports to maintain grain availability, reducing opportunities to accumulate strategic grain reserves capable of cushioning supply shocks, natural disasters and market disruptions (FAO, 2008).

Recent evidence indicates that Nigeria's grain food security challenges have intensified due to weaknesses in the management of the National Strategic Grain Reserve (NSGR) system. Although the country possesses an estimated grain storage capacity of about 1.3 million metric tonnes, many strategic reserve facilities remain underutilized because of inadequate funding, poor maintenance, insecurity, weak institutional coordination and infrastructure deficits (Federal Ministry of Agriculture and Food Security [FMAFS], 2023). By 2023, only a few government-managed reserve facilities were fully operational, while available grain stocks amounted to only about 100,000 metric tonnes, representing approximately 7.7% of the minimum reserve requirement needed to provide six months of emergency food security (FMARD & AGRA, 2023).

The study further highlights limited transparency in strategic grain reserve management, with inadequate public information on grain procurement, storage and releases. Government participation in grain markets also remains relatively weak, accounting for less than 0.4% of national grain supplies, thereby limiting its capacity to stabilize food prices during periods of scarcity (National Bureau of Statistics [NBS], 2022). These findings agree with the Food and Agriculture Organization, which reported that reducing postharvest losses represents one of the most cost-effective approaches to improving food availability and strengthening food security (FAO, 2019).

Macroeconomic conditions have further aggravated food security challenges. Exchange rate depreciation has increased the cost of imported food commodities, while rising transportation costs have contributed to higher food prices. Under these conditions, domestic production alone cannot adequately compensate for import dependence when substantial postharvest losses continue to reduce market supplies. Although the release of strategic grain reserves temporarily moderated food prices, experts have emphasized that such interventions are unsustainable unless reserve stocks are regularly replenished and efficiently managed (Zero Hunger Nigeria, 2025).

Overall, the study concludes that Nigeria's grain food security challenges result from the combined effects of rapid population growth, insufficient growth in domestic grain production, increasing dependence on grain imports, weak strategic grain reserve management, high postharvest losses and inefficient food supply systems. Addressing these challenges will require integrated policy interventions that enhance agricultural productivity, strengthen strategic grain reserve operations, reduce postharvest losses, improve storage and transportation infrastructure, promote market transparency and increase investment across the agricultural value chain. These interventions are consistent with the objectives of the National Agricultural Technology and Innovation Policy (NATIP) 2022–2027, the Comprehensive Africa Agriculture Development Programme (CAADP), and the United Nations Sustainable Development Goal 2 (Zero Hunger), all of which advocate resilient food systems, sustainable agricultural productivity and improved food security.

Conclusion

This study evaluated Nigeria's grain food security using selected indicators comprising population growth, grain production, grain imports, grain exports

and grain demand over the period 2006–2015. The findings revealed that domestic grain production did not keep pace with the country's rapidly increasing population, resulting in widening disparities between grain supply and demand. Correlation analysis further showed weak negative relationships between grain production and imports, exports, and demand, while a moderate positive relationship existed between population growth and grain imports, indicating increasing dependence on imported grains to satisfy domestic consumption. Weak strategic grain reserve management, high postharvest losses, inadequate storage infrastructure, insecurity, climate variability and inefficient food supply chains have compounded Nigeria's food security challenges. The study concludes that achieving sustainable grain food security in Nigeria requires an integrated policy approach that simultaneously enhances agricultural productivity, strengthens postharvest management, improves strategic grain reserve operations, and promotes resilient agricultural value chains capable of meeting the food demands of a rapidly growing population.

Recommendations

1. The Federal Ministry of Agriculture and Food Security, in collaboration with state ministries of agriculture, should strengthen domestic grain production through targeted support for improved seed varieties, affordable farm inputs, irrigation facilities, mechanized farming services, and effective agricultural extension programmes. Priority should be given to major grain-producing areas and smallholder farmers to increase domestic supply and reduce dependence on imported grains.
2. The Federal Ministry of Agriculture and Food Security and the agencies responsible for the National Strategic Grain Reserve should rehabilitate non-functional silos, establish routine maintenance programmes, ensure regular procurement and replenishment of grain stocks, and develop transparent procedures for the release of stored grains during food shortages, emergencies, and severe market disruptions.
3. Federal and state governments, agricultural development programmes, farmers' cooperatives, and private agribusiness firms should reduce postharvest losses by expanding access to modern grain-drying facilities, hermetic storage systems, warehouses, processing centres, and reliable rural transportation. Extension officers should also provide farmers with practical training on harvesting, drying, handling, storage, pest control, and grain quality management.
4. The Federal Ministry of Agriculture and Food Security, the Nigerian Meteorological Agency, research institutes, and agricultural extension agencies should expand climate-resilient grain production. Interventions should include wider access to drought-tolerant and flood-tolerant crop varieties, small-scale irrigation, water conservation systems, timely weather information, agricultural insurance, and location-specific planting guidance for farmers.
5. The Federal Government, state governments, security agencies, and community authorities should strengthen security arrangements in major grain-producing areas. Measures should focus on protecting farming communities, improving safe access to farmland and markets, restoring agricultural activities in conflict-affected communities, and protecting critical agricultural infrastructure and transportation routes.
6. The National Bureau of Statistics, the Federal Ministry of Agriculture and Food Security, research institutions, and relevant agricultural agencies should establish an integrated national grain information system for regular monitoring of production, consumption, imports, exports, market supply, storage levels, and prices. The system should provide timely information for production planning, reserve management, import decisions, and responses to emerging food supply risks.

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Appendices

Table 1: Nigeria Estimated Population for 2006 – 2015

YEAR	POPULATION (millions)
2006	143.00
2007	147.15
2008	151.00
2009	155.21
2010	159.42
2011	164.77
2012	168.24
2013	172.82
2014	177.48
2015	188.20

Source: World Development Indicator, 2016

Table 2: Nigeria Estimated Agricultural Grain Crops Production for 2006 – 2015

YEAR	GRAIN CROP /PRODUCTION (OUTPUT) Tonnes (T)						TOTAL
	Rice (milled)	Wheat	Maize	Soybeans	Sorghum	Millet	
2006	2,873,420	-	7,023,000	1,650,090	6,474,000	5,940,000	23,960,510
2007	3,186,000	44,000	5,796,670	580,000	5,429,000	4,388,000	19,423,790
2008	4,179,000	53,000	9,113,710	591,000	5,218,400	4,327,610	23,482,720
2009	3,546,250	37,000	7,338,840	610,000	5,271,000	4,884,890	21,687,980
2010	4,472,520	34,200	7,669,180	460,000	7,133,820	5,167,090	24,936,810
2011	4,700,000	100,000	8,800,000	500,000	6,500,000	1,000,000	21,600,000
2012	2,709,000	100,000	9,250,000	510,000	6,900,000	5,000,000	24,469,000
2013	2,370,000	70,000	7,630,000	650,000	6,493,000	5,000,000	22,213,000
2014	2,772,000	70,000	7,700,000	650,000	6,592,000	5,200,000	22,984,000
2015	2,900,000	100,000	10,800,000	-	7,000,000	-	20,800,000

Sources : FAO, 2014, 2016; FAOSTAT 2011, 2014, 2016

: USDA, 2011 – 2015

: National Bureau of Statistics, 2010

: World – Grain. Com,

: - Data unavailable for these years

Table 3: Estimated Nigeria Agricultural Grain Crops Export for 2006 – 2015

YEAR	GRAIN CROP EXPORT IN (Tonnes)						TOTAL
	Rice (milled)	Wheat	Maize	Soybeans	Sorghum		
2006	2,497	15	3,666	11,500	699	18,377	
2007	251	82	10,416	15,300	378	24,427	
2008	46	12	1,023	15,000	17	16,098	
2009	-	12	-	14,400	30	14,488	
2010	0	200,000	35	0	100,000	300,035	
2011	0	570,000	100,000	0	60,000	730,000	
2012	0	480,000	100,000	0	70,000	650,000	
2013	0	450,000	50,000	0	0	500,000	
2014	0	500,000	100,000	0	30,000	630,000	
2015	0	500,000	200,000	-	100,000	800,000	

Sources : FAOSTAT, 2012 Food Security Portal

: Grain and Feed Annual Report, 2011- 2015

: FAO, FoodOutlook, 2010

: - Data unavailable for these years

Table 4: Estimated Nigeria Agricultural Grain Crops Import for 2006 -2015

YEAR	GRAIN IMPORT IN Tonnes (T)						TOTAL
	Rice (milled)	Wheat	Maize	Soybeans	Sorghum		
2006	1,000,000	3,244,000	9,612	23,124	0	4,276,736	
2007	1,216,962	7,795,100	687	23,124	24	9,035,897	
2008	971,815	1,132,180	49	83	12,601	2,116,728	
2009	1,056,000	1,134,000	29	-	12,000	2,202,029	
2010	2,100,000	3,400,000	400,000	4,000	-	5,904,000	
2011	2,400,000	4,051,000	100,000	4,000	13,000	6,568,000	
2012	2,890,000	3,800,000	100,000	10,000	0	6,800,080	
2013	2,500,000	4,140,000	100,000	-	0	6,740,000	
2014	3,000,000	4,215,000	100,000	-	0	7,315,000	
2015	3,500,000	4,350,000	100,000	-	0	7,950,000	

Sources: Food Security portal

: World – Grain.com, 2015

: FAOSTAT, 2012.

: USDA, 2011 - 2015

: FAO, Food Outlook, 2010

: - Data unavailable for these years

Table 5: Estimated Nigeria Agricultural Grain Crops Demand for 2006 -2015

YEAR	GRAIN CROPS/ FOOD DEMAND IN Tonnes (T)					
	Rice (Milled)	Wheat	Maize	Soybeans	Sorghum	TOTAL
2006	5,200,000	3,243,985	7,028,985	1,667,174	5,216,871	23,351,516
2007	3,100,000	7,839,018	5,786,944	587,824	5,428,766	22,742,552
2008	3,000,000	1,185,168	9,112,736	586,083	5,205,782	19,089,769
2009	2,800,000	1,170,988	7,338,869	595,600	5,282,970	17,188,247
2010	5,000,000	3,581,000	8,069,145	454,000	7,146,803	24,250,948
2011	5,030,000	3,490,000	8,825,000	484,000	6,690,000	24,519,000
2012	5,200,000	3,970,000	9,250,000	520,000	6,790,000	25,730,000
2013	5,000,000	3,970,000	7,800,000	650,000	6,850,000	24,270,000
2014	6,000,000	3,835,000	7,700,000	650,000	6,830,000	25,015,000
2015	6,000,000	3,920,000	7,511,000	-	6,600,000	24,031,000

Sources: Agricultural Transformation Agenda, 2011

: USDA, 2011-2015

: - Data unavailable for this year