

## Global Food and Energy Crises: The Need for Sustainable Food Security and Renewable Energy Programmes in Nigeria

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**Abstract:** The study examines the need for sustainable food security and renewable energy programmes in Nigeria bearing in mind the global energy and food crises. While the global energy crisis centred on fuel crisis (price increase), Nigeria's energy crisis is a combination of fuel and electricity crises. Annual crude oil production and annual average price of crude oil per barrel significantly influenced the output of major agricultural product ( $p < 0.05$ ). Increase in demand for fuel and Middle East Political problem are found to be the major reasons for global oil crisis. The study showed that fuel crisis in Nigeria can also be attributed to poor state of refineries, Niger Delta crisis, and pipeline vandalization among others. Causes of electricity crisis include corruption, over reliance on hydroelectricity and poor maintenance. On the other hand, the study revealed that global food crisis is caused by bio-fuel, global warming and energy crisis. Apart from these reasons; over-reliance on imported food (e.g. rice), poor infrastructural facilities (road, electricity, storage etc.) and over-dependence on oil are other identified causes of food crisis in Nigeria. The effects of these crises are manifested in rising cost of production and food prices - a threat to food security and poverty reduction. Increased food production, infrastructural development, use of green and organic manure to reduce high demand for chemical fertilizers and pesticides are suggested solutions to food crisis while energy conservation strategies and development of alternative sources of electricity (solar and wind) are some of the proffered solutions to energy crisis.

**Key words:** Energy crisis, renewable energy, global warming, biofuel and food security

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### INTRODUCTION

In an agrarian economy, land as an important resource for agricultural production provides the needed fulcrum upon which a sustainable development would blossom. Agricultural production till date remains the mainstay of the Nigerian economy (Okuneye, 2002). It is the main source of food for most of the population. It provides the means of livelihood for over 70% of the population, a major source of raw materials for the agro-allied industries and a potent source of the much needed foreign exchange (Human Development Report, 1998; Okumadewa, 1997).

Okuneye, (2002) posited that the agricultural sector performed creditably the roles highlighted above in periods immediately after independence, to such an extent that the regional development witnessed during these period were linked directly to the sector. However, over the years, the sector has witnessed a tremendous decline in its contribution to national development. For an instance, the percentage of economically active population in agriculture nose-dived to 50-52 % in late 1990s. Okuneye (2002) opined that the inconsistent and unfocussed government policies have been described as the fatal perturbations that rocked the boat of food security in Nigeria. Thus, making the agricultural sector

to be found wanting in all its roles, most especially food production. The consequence has been increase in food importation to augment the shortfall in production Table 1. Staple food like rice, wheat, maize, soyabean and vegetable oil are the major food imports. Specifically, Nigeria spent more than \$100million on rice importation (the major staple whose demand is constantly on the increase) between 1961 and 1999.

The import bill on rice has been put at \$259, \$655 and \$578 million in 1999, 2001 and 2002, respectively (Tell; October 20, 2008). A handful of countries dominate the global trade in staple foods. 80% of wheat exports come from six exporters, as does 85% of rice. Three countries produce 70% of exported corn. This leaves the world's poorest countries, the ones that must import food to survive, at the mercy of economic trends and policies in those few exporting companies. When the global food trade system stops delivering, it's the poor who pay the price (Angus, April 28, 2008). Food crisis is not new to the developing countries most especially the Sub Saharan Africa that have depended on the developed countries for food either in term of importation or food aids despite the potential to produce enough food for the teeming population. The relative food security being enjoyed by these countries including Nigeria can be attributed to these reasons (food importation and food aids). However,



Table 1: Values of food imports (Nmillion) 1970-2007.

Year	Food Import (Nmillion)	Year	Food Import (Nmillion)	Year	Food Import (Nmillion)	Year	Food Import (Nmillion)
1970	57.5	1980	1437.5	1990	3474.5	2000	13695.38
1971	88.3	1981	1819.6	1991	6085.1	2001	17271.85
1972	95.8	1982	1642.3	1992	12597.2	2002	18848.32
1973	126.3	1983	1296.7	1993	13192.9	2003	15424.79
1974	154.8	1984	843.2	1994	13836.7	2004	19001.26
1975	298.8	1985	940.6	1995	19204.7	2005	16577.73
1976	441.7	1986	801.9	1996	19003.4	2006	15154.2
1977	780.7	1987	1646.5	1997	11389.5	-	-
1978	1027.6	1988	1220	1998	12542.44	-	-
1979	952.2	1989	2108.9	1999	13118.91	-	-

Source: Several issues of CBN statistical bulletin.

with the current global food crisis and high level of poverty in these countries, the food security is being threatened.

**Defining food security:** Many definitions of food security have been proposed and there is not a universally accepted definition (Bredahl *et al.*, 1999). The most frequently cited definitions are developed by the World Bank: 'Food security is access by all people at all times to enough food for an active, healthy life' (Reutlinger and Pellekaan, 1986). According to Dorélien (2008) food security is defined as "when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life. It is usually studied through three dimensions: food availability, food access and biological utilization/absorption of food. Food availability is achieved when sufficient quantities of food are consistently available to all individuals within a country. Such food can be supplied through household production, other domestic output, commercial imports, or food assistance. The effects of current global food crisis would not have been this serious if developing countries like Nigeria rely on domestic production of her staple food like rice instead of relying on importation for her food availability. Food access is ensured when households and all individuals within them have adequate resources to obtain appropriate foods for a nutritious diet. Access depends on income available to the household, on the distribution of income within the house hold and on the price of food. The greatest challenge of food security (food access) is the high incidence of poverty in Nigeria which is put at 54.4% by National Bureau of Statistics (2005). There is high income inequality while prices of food continue to increase. Poor families spend up to 80% of their budget on food (Project Concern International, 2008). Food utilization is the proper biological use of food, requiring a diet providing sufficient energy and essential nutrients, potable water and adequate sanitation. Effective food utilization depends in large measure on knowledge within the household of food storage and processing techniques, basic principles of nutrition and proper child care, USAID, Food Aid and Food Security.

**The meeting point of food and energy crises:** Food production is heavily dependent on hydrocarbons for energy, in the form of petroleum to power machinery and transport goods to market. Another important input is fertilizer usage that is highly dependent on natural gas for

its production and sometimes for fuelled irrigation. Thus, when fuel costs increase crop production costs will also soar (Pimentel *et al.*, 1973). The increasing cost of grains is also pushing up the price of meat, poultry, eggs and dairy products. And there is every likelihood prices will continue their relentless rise, according to expert predictions by the UN and developed countries. Until recently, the price of oil keeps going up negating the laws of supply, demand and the food prices has also become so increasingly inflated that a food shortage is promoted creating a worldwide panic.

According to Wikipedia (2008), crisis is any great bottleneck (or price rise) in the supply of a resource to an economy. Energy crisis is a situation in which the nation suffers from a disruption of energy supplies accompanied by rapidly increasing energy prices/power interruption that threaten economic and national security. The threat to economic security is represented by the possibility of declining economic growth, increasing inflation, rising unemployment and losing billions of dollars in investment (Williams and Alhaji, 2003). The threat to national security is more associated with electricity crisis; in terms of prolonged blackout (most especially at night) which may result in field day for nefarious activities like armed robbery, kidnapping and assassination among others. The energy crisis in Nigeria is more of electricity than oil. Food crisis on the other hand refers to shortage of food which often leads to price increase. Food crisis situation brings about food insecurity; it is either basic food items are scarce (food not available) or where they are available; the prices may be too high for consumer to bear (food not accessible). The global energy crisis centred on the increase in the price of crude oil in the world. However, the Nigeria situation like any other oil producing countries in the world is quite different. While it was a crisis situation in non oil producing countries, the oil producing countries have benefited from the increase in price of crude oil through increase in revenue which surpassed the budgeted revenue from crude oil. Past energy crisis that Nigeria has benefited in terms of revenue include:

- 1973 oil crisis-Cause: an OPEC oil export embargo by many of the major Arab oil-producing states, in response to western support of Israel during the Yom Kippur War.
- 1979 energy crisis-Cause: the Iranian revolution.
- 1990 spike in the price of oil-Cause: the Gulf War.



The problem now is: how such huge revenue is expended to provide basic infrastructure and to cushion whatever effect of the crisis on the populace? Moreover, the energy crisis in Nigeria is more of electricity crisis than petroleum crisis. The reasons for energy crisis in Nigeria are mainly internal unlike the global energy crisis caused by increase in price of fuel.

The broad objective of this paper is to examine the need for sustainable food security and renewable energy programmes in Nigeria bearing in mind the global energy and food crises. The specific objectives are:

- To highlight the state of food production in Nigeria
- To examine the effects of global food and energy crises on national food security
- To examine the causes of global food and energy crises most especially electricity crisis as it relates to Nigeria, to analyse the effects of crude oil output per year ('000 barrel), average crude oil price per barrel per year (\$) and natural gas output per year (million cubic metres) on the output of major agricultural commodities per year, parenthesis
- To suggest policy recommendations that will enhance sustainable food security

#### **Energy (electricity) and food security:**

**Importance of regular electricity supply:** The importance of power in form of electricity in economic development and sustain ability of food security of a country can not be overemphasized. Power is required for food processing, preservation of perishable food products, for transportation of farm produce from the farm to the market in order to create time utility on the product. This will enhance food availability. Industries require electricity for powering heavy industrial machines for production of goods. Artisans like welder, barber, carpenter, electrician, Radionic, computer operator among others cannot operate without electricity. Regular supply of electricity helps to reduce poverty thus enhancing the purchasing power of the populace. Adequate resources (example is money) by the Nigerians to perform effective demand is germane to the tenet of food security (food access). The need for electricity in our homes for domestic use as well as for security (lightening the environment) makes it indispensable.

**Current State of Nigerian electricity:** Electricity supply in the country by Power Holdings Company of Nigeria (PHCN) for the past 8 years has grown from bad to worse. It was with unusual candour last month (March, 2007) that government accepted that since the advent of electricity in Nigeria, the country was undergoing its worst power crisis. Specifically, Makoju (2007) admitted that indeed, the power utility has failed the country, as a combination of factors has made it to produce at an all time low. Presently, it is estimated that Nigeria may be producing a mere 600 mw from an installed capacity of 4000 mw. Electricity supply is characterized by fragment

outages most especially within industrial estate in cities and town like Lagos, Aba, Onitsha, Kaduna and Kano where a good number of industries are located (Mayah, 2007). NACCIMA (2006) half year review report gave a verdict of abysmal failure in the power sector, the group indicated that industrial capacity utilization fell significantly from 48.1% recorded in the proceeding half year to 42.6%.

The Organized Private Sector which is made up of MAN, NACCIMA and NECA has consistently noted that the cost of goods and services are 20 percent higher due to energy problem. According to the OPS, the cost of energy includes maintenance of in-house power plants and payment for services poorly rendered by PHCN have combined to impede industrial growth and shoot up cost of doing business, in the country. Presently, industries rely on diesel and petrol generators to power their plants. According to Mayah, (2007) other consumers of public electric power nation wide are worse off. He revealed that extended hours of outages have inflicted crushing impact on small business and the average household. Seriously affected are Small and Medium Scale Industries (SMIs) which could not provide their own power supply alternative on account of low financial capacity. There has been counter accusation on the reasons for the sorry state of public electric power: Government is accusing Niger Delta militant of vandalizing gas pipelines that supplies gas to PHCN (Egbin thermal station). Binnyat (2007) accused the Nigerian Gas Company (NGC) of smothering out the last gas supply from an augmenting gas pipeline last month to finally bring electricity production to zero at Egbin. Again, he accused the forces of nature in compounding the problem, when he observed that the Hydro-Power plants were producing at an all time low because of the peak of the dry season.

**Electricity crisis and the failed effort:** Binnyat (2007) revealed that a whopping N1.3 trillion has been committed to maintain the old power stations and build new independent power stations across the country. The National Independent Power Plants (NIPP) is made up of the 451 mw Gbarian Power station in Bayelsa State; 230 mw Ihovbor station in Edo State, the 230 mw Gas Thermal station at Omoku, Rivers State and the Sapele 451 mw power station in Delta State. The rest are the Egbema 338 mw power station in Imo State; the Calabar 561 mw station in Cross River State and the 188 mw Ibom Power plant in Akwa Ibom State. Apart from Papalanto, Ogun State, designed to produce 335 mw of electricity and another 335 mw Omotosho Gas thermal station worth N37 billion. In the area of maintenance, according to government sources 1,701 km of new 33 kv lines; 2,666 km, of new 11 kv lines and additional 3,540 MVA sub-station capacity and 22,598 transformers have been put in place. Government also claimed to have connected a total of 662 local government headquarters to the National grid since 1999. The huge spending has not transformed to the improvement in public power supply.



The commissioning of the project has been postponed many times. There has also been complaint here and there about the quality of the jobs the Chinese handling the NIPP projects are doing. The revelation at the just concluded power (electricity) probe is an indication that the colossal amount has been wasted.

The new administration is thinking of declaring state of emergency in the power (electricity) sector.

**Effects of electricity crisis:** The resultant effect of this problem has been increase in the closure of many industries. Recently Michelin (tyre manufacturer) folded up on account of unbearable poor electricity supply by PHCN. According to Nigeria Labour Congress (NLC), over 70 factories have so far closed down since, 2002 in Apapa Industrial Estate alone, thus many employees are being laid off. Furthermore, the epileptic public power supply nation wide has turned many well trained small scale business operators (Welder, Bricklayers, Carpenters, Mechanics, Vulcanizes, Video club operators among others) to commercial motor cycle operators (Okada). With its attendant risk, many of these artisans are exposed to accidents and other hazards. The necessary economic growth to generate income-earning opportunities (self and paid employment) for poverty alleviation cannot be achieved with the current epileptic supply of electricity nationwide.

**Record prices for staple foods and crude oil:**

**Stable foods:** The unprecedented worldwide food price inflation has driven prices to their highest levels in decades. The increases affect most kinds of food, but in particular the most important staples-wheat, corn and rice.

The UN Food and Agriculture Organization says that between March 2007 and March 2008 prices of cereals increased 88%, oils and fats 106% and dairy 48%. The FAO food price index as a whole rose 57% in one year and most of the increase occurred in the past few months.

Another source, the World Bank, says that in the 36 months ending February 2008, global wheat prices rose 181% and overall global food prices increased by 83%. The Bank expects most food prices to remain well above 2004 levels until at least 2015.

The most popular grade of Thailand rice sold for \$198 a tonne five years ago and \$323 a tonne a year ago. On April 24, 2000 the price hit \$1,000.

These increases are catastrophic for the 2.6 billion people around the world who live on less than US\$2 a day and spend 60 to 80% of their incomes on food. Hundreds of millions cannot afford to eat.

In Nigeria, 50kg bag of rice was sold for between N10,000 and N12,000 up till September 2008 as against N6,000 in 2007 (Tell; October 20, 2008). This is an indication of failure to harness the abundant national resources (arable land, water and fuel) to produce enough food for the teeming population of Nigerian.

**Crude oil:** The price of crude oil in the world market (Historical Crude Oil Prices, 2008) experiences sharp increase from January 2008 and reach its peak on July 11,

2008, with record price of \$147.27 per barrel (Table 2).

The price of a barrel of oil is highly dependent on both its grade, determined by factors such as its specific gravity or API and its sulphur content and its location. The demand for oil is highly dependent on global macroeconomic conditions. Some economists say that high oil prices have a large negative impact on the global growth.

**Causes of global energy (fuel) crisis:**

- The growth of the middle class and economic growth in developing countries have also increased global energy demand. Rising petroleum use in developing countries has contributed to rising oil prices. Most especially India and People's Republic of China that are currently experiencing rapid economic growth.
- Major oil-exporting countries are rapidly developing and are using more oil domestically. Particularly significant are Indonesia, which no longer exports oil, Mexico and Iran, where projected demand will exceed production in about five years and Russia, which is growing rapidly.
- Political turmoil in the Middle East-the region of many oil producing countries and militant activities in Niger-delta of Nigeria. For instance on July 11, 2008, oil prices rose to a new record of \$147.27 following concern over recent Iranian missile tests.
- Price increase of crude oil can also be attributed to speculation. For instance, when US trading was allowed to take place through the US-owned ICE Futures exchange in London rather than the NYMEX, thereby escaping US regulatory requirements.

Other causes of energy (fuel) crisis that are peculiar to Nigeria are:

- Frequent increase in pump price of fuel by government in compliance with International Monetary Fund conditions for loan or to reflect international market price - the source of domestic fuel consumption. See the increment in pump price of fuel over the years in the Table 3. Importation of refined crude oil is as a result of the poor state of the refineries. Increment in fuel price usually accompanied by labour strike is always preceded by speculation, long queues at filling stations.
- High level corruption that has made the maintenance of refineries and pipelines not to function effectively.
- Strikes and threats to embark on strike by National Union of Petroleum and Gas Workers (NUPENG) and PENGASAN. This action or inaction often leads to long queues at filling station and hoarding of petroleum products.
- Vandalisation of fuel pipelines has often resulted in interruption of fuel supply.
- Vandalisation of fuel pipelines, kidnapping of oil workers and disruption of oil exploration in Niger-Delta by militants.



Table 2: Monthly Average Domestic Crude Oil Prices 2008 U.S. Average (in \$/bbl.)

Month	Nominal price(\$)
Jan-08	084.70
Feb-08	086.64
Mar-08	096.87
Apr-08	104.31
May-08	117.40
Jun-08	140.00
Jul-08	139.09
Aug-08	112.00
Sep-08	100.07
Oct-08	069.32

Sources: Inflation Data.com and Wikipedia (2008)

Table 3: Trend In Petrol Price (N) Increase in Nigeria.

Date	Price Per Litre	Regime	Increase
Jan. 1, 1999	42 Kobo for Commercial vehicles and 60 Kobo for Private vehicles	Gen. Ibrahim Babangida	43.0%
Dec. 19, 1989	60 Kobo for all	Gen. Ibrahim Babangida	43.0%
March 6, 1991	70 Kobo	Gen. Ibrahim Babangida	16.6%
Nov. 8, 1993	N5.00	Chief Ernest Shonekan	614.0%
Nov. 22, 1993	N3.25	Gen. Sani Abacha	
October 2, 1994	N15.00	Gen. Sani Abacha	361.5%
October 4, 1994	N11.00	Gen. Sani Abacha	
Dec. 0, 1998	N25.00	Gen. A. Abubakar	127.0%
January 6, 1999	N20.00	Gen. A Abubakar	
June 1, 2000	N30.00	Chief Olusegun Obasanjo	50%
June 8, 2000	N25.00	Chief Olusegun Obasanjo	
June 13, 2000	N22.00	Chief Olusegun Obasanjo	
January 1, 2002	N26.00	Chief Olusegun Obasanjo	18.2%
June 20, 2003	N40.00	Chief Olusegun Obasanjo	53.0%
July 9, 2003	N34.00	Chief Olusegun Obasanjo	
October 1, 2003	N38.50 and N42	Chief Olusegun Obasanjo	
May 29, 2004	N49.90	Chief Olusegun Obasanjo	
January 2005	N50.50	Chief Olusegun Obasanjo	
August 2005	N65	Chief Olusegun Obasanjo	

Source: Petrol increase in Nigeria: The truth you must know. A book written by Gani Fawehinmi

### Causes of global food crisis:

**Population growth:** Population growth has been the most discussed demographic dimension of the food crisis because of its very direct impact on the growth in food demand. Last year the world population grew by 1.2% and it is expected to reach 7 billion in 2012 and 9.3 billion in 2050. Demand for food is projected to double by 2030 and 20% of that increase is attributed to population growth. Neither population growth nor food production is evenly distributed across the globe. For example, the Total Fertility Rate (TFR), a measure of the average number of children a woman will have over her lifetime, in Nigeria in 2005 was 5.4 compared to the world average of 2.7 (UNDP Human Development Report, 2005). Rural fertility is particularly high and stagnant in most countries, such as Uganda, Burundi and Ethiopia and when combined with lowering mortality, is resulting in rapid population growth. The relationship between population growth and food security is not limited to increased demand for food. Population growth can also have an impact on the food supply and access. In many areas population growth has been associated with land

fragmentation and resettlement schemes in fragile environments that directly affect food production. Specifically, land fragmentation contributes to inefficient and destructive farming practices and increased cultivation of marginal land, which often reduces food production (Dorélien, 2008).

**Biofuel:** This refers to fuel (examples are ethanol and biodiesel) generated from agricultural product such as maize, cassava, sugarcane and oil palm among others. The high price of petrol has been given as the reason for alternative energy source. Biofuel has brought about diversion of farmland or crops for bio-fuel production in detriment of the food supply on a global scale. A World Bank policy research working paper published on July 2008 concluded that bio-fuel produced from grains have raised food prices in combination with other related factors between 70 to 75%, but ethanol produced from sugar cane has not contributed significantly to the recent increase in food commodities prices. Mitchell (2008) in a World Bank policy research working paper concluded that bio-fuel produced from grains have raised food prices in combination with other related factors between 70 to 75%, but ethanol produced from sugar cane has not contributed significantly to the recent increase in food commodities prices. Glantz (2008) opined that if petrol prices were not so high (and increasing); it is likely the movement into bio-fuel would have remained pretty unspectacular. Governments need energy to keep their economies running and growing. According to IFPRI Report (2008) biofuel demand is increasing because of a combination of growing energy needs; rising oil costs; the pursuit of clean, renewable sources of energy; and the desire to boost farm incomes in developed countries. In turn, [www.celsias.com/](http://www.celsias.com/) Figure 1 the need for crops - such as maize and sugarcane - to be used as feed stocks for bio-fuel has increased dramatically. Concern about global warming and a chance to save or make money from bio-fuel has prompted many governments to launch crash (that is, hurried) programs to produce them for domestic use or for export. Some countries focus on converting corn to ethanol (USA), while others focus on sugar cane (Brazil) and still others focus on oil palm (Indonesia). To do so, the land on which to grow this stuff has to come from somewhere and, where there is no suitable land available, food producing areas (as well as nature preserves) become candidates for takeover by relentless pressure on government from the biofuel producers.

**Climate change:** Scientists say that climate change could cut food production in parts of the world by 50% in the next 12 years. But that isn't just a matter for the future: Australia is normally the world's second largest export of grain, but a savage multi-year drought has reduced the wheat crop by 60% and rice production has been completely wiped out. In Bangladesh in November, one of the strongest cyclones in decades wiped out a million tonnes of rice and severely damaged the wheat crop,



making the huge country even more dependent on imported food. Other examples abound. It's clear that the global climate crisis is already here and it is effecting food (Angus, 28 April 2008).

**Urbanization and its effect on food demand and supply:** The world is becoming increasingly urban and by the end of 2008, more than half of the world's population will be living in urban areas. Future population growth is expected to occur almost exclusively in urban areas. By 2030, the world's urban population is expected to reach 4.9 billion, while the rural population is expected to decrease by 28 million (Dorélien, 2008). Furthermore, the pace of urbanization will grow the fastest in regions that currently have low levels of urbanization, such as in East Africa. Consequently, these regions will have a growing non-agricultural population that relies on purchased food and is susceptible to increases in food prices. Urbanization, like income growth, is associated with increased consumption of meat, fruits and vegetables. Urbanization is also often associated with decreases in food supply due to a loss of agricultural land and dietary diversification. The expansion of urban space tends to affect farm lands because many cities and towns are located in rich agricultural lands. A compounding factor is that urban growth is increasingly land-intensive. Urban space grows faster than urban populations, evident as urban sprawl. Cities and their growing populations also increasingly compete with the agricultural sector for scarce water resources, resulting in less water for irrigation.

**Oil prices:** The price of food is linked to the price of oil because food can be made into a substitute for oil. But rising oil prices also affect the cost of producing food. Fertilizer and pesticides are made from petroleum and natural gas. Gas and diesel fuel are used in planting, harvesting and transporting Agricultural products. It has been estimated that 80% of the costs of growing maize in medium and large scale farming are fossil fuel costs (Pimentel et al., 1973) so it is no accident that food prices rise when oil prices rise.

Furthermore, apart from the aforementioned causes of global food crisis, Nigeria food crisis can also be attributed to:

- Reliance on importation of agricultural products that can be produced locally
- Lack of storage facilities for farmers to store their excess product during harvest for lean season
- Too much emphasis on rain fed agriculture
- Inconsistency in government agricultural policy
- Over reliance on crude oil
- Poor infrastructural development of the rural areas where more than 86% of the population resides (PRB)
- Poor funding and coordination of extension services

#### **Effects of global food and energy crises:**

- High food and fuel prices will increase the number of malnourished people around the world in 2008 by 44 million to reach a total of 967 million, said a report released by the World Bank on Wednesday.
- Increase in price of crude oil is source of additional revenue for oil producing countries like Nigeria.
- Increase in price of fossil fuel has indirectly increased the profit margin of maize (United states of America), soyabean, sugarcane (Brazil), palm oil (Indonesia) farmers in countries where these products are used for bio-fuel.
- Cost of production increases in both agricultural and non agricultural sectors.
- Poor families around the world are being pushed to the brink of survival, causing irreparable damage to the health of millions of children. As families cut back on spending, there are also grave risks for the educational performance of poor children.
- High price depresses the economies of the oil consuming nations.
- Riots as a result of increase in food price. Food riots have been reported in Haiti, Mexico, Senegal, Burkina Faso, Côte d'Ivoire, Bangladesh, Pakistan and Thailand to mention a few.
- A threat to the realisation of United Nations Millennium Development Goal of reduction of the world poor by half in 2015.
- Aid organizations that buy food and send it to poor countries mostly in sub Saharan Africa are only able to send half as much food on the same budget if prices double. But the higher prices mean there are more people in need of aid.
- Poor people feel full impact of rising food prices more than the rich. The poor buy more grains like rice, beans and wheat unlike the rich that prefers processed food whose price don't change much if the raw material changes.

#### **MATERIALS AND METHODS**

Secondary data on annual output of major agricultural commodities ('000 tonnes), annual crude oil production ('000 barrels), average price of crude oil (\$) per year, annual natural gas production (million cubic metres) were used for the study. The data from 1970-2007 were extracted from several issues of central bank statistical bulletin and inflationData.com. Some of the major agricultural commodities considered are rice, beans, sorghum, soyabean, yam, cassava, maize, groundnut, tomato and millet.

**Method of data analysis:** Multiple regression analysis was used to achieve specific objective (iv) of the study. The regression equation model was specified explicitly in accordance with ordinary least square approach as shown in the Eq. 1 below:



$$MAC = a_0 + a_1 APC + a_2 COP + a_3 NGP + U_0 \quad (1)$$

Where:

MAC represents annual output of major agricultural commodities ('000 tonnes)

APC represents annual average price of crude oil (\$)

COP represents annual crude oil production ('000 barrels)

NGP represents annual natural gas production (million cubic metres)

$U_0$  represents random term

$a_i$  represents regression coefficient of parameters ( $i = 0, 1, 2, 3$ )

The data were fitted into four function forms (Linear, Cobb-Douglas, Semi-log and exponential functions) below:

$$\text{Linear: } MAC = a_0 + a_1 APC + a_2 COP + a_3 NGP + U_0 \quad (2)$$

$$\text{Cobb - Douglas: } \ln(MAC) = \ln a_0 + a_1 \ln(APC) + a_2 \ln(COP) + a_3 \ln(NGP) + U_0 \quad (3)$$

$$\text{Semi - log: } MAC = \ln a_0 + a_1 \ln(APC) + a_2 \ln(COP) + a_3 \ln(NGP) + U_0 \quad (4)$$

$$\text{Exponential: } \ln(MAC) = a_0 + a_1 APC + a_2 COP + a_3 NGP + U_0 \quad (5)$$

The selection of the lead equation (best functional form) was based on high coefficient of determination (adjusted) statistical significance of the individual regression coefficient and  $F^{cal}$  conformity of the algebraic sign on the estimate of regression coefficients to a priori expectations. However, some trade offs are involved in the use of these criteria because it is rare for a single model to fulfil all over and above other competing models or functional forms.

The a priori expectations are:

1.  $a_1 < 0$  (coefficient of annual average price of crude oil (\$) is less than zero, this means that as annual average price of crude oil (\$) increases annual output of major agricultural commodities decreases).
2.  $a_2 < 0$  (coefficient of annual crude oil production ('000 barrels) is less than zero; this means that as annual crude oil production ('000 barrels) increases annual output of major agricultural commodities decreases).
3.  $a_3 < 0$  (coefficient of annual natural gas production (million cubic metres) is less than zero, this means that annual natural gas production (million cubic metres) increases annual output of major agricultural commodities decreases).

Moreover, the following hypotheses were tested on whether the regression coefficients are statistically or not:

$H_0 : a_1 = 0$  (coefficient of annual average price of crude oil (\$) is not statistically different from zero).

$H_1 : a_1 < 0$  (coefficient of annual average price of crude oil (\$) is statistically different from zero).

$H_0 : a_2 = 0$  (coefficient of annual crude oil production ('000 barrels) is not statistically different from zero).

$H_1 : a_2 < 0$  (coefficient of annual crude oil production ('000 barrels) is statistically different from zero).

$H_0 : a_3 = 0$  (coefficient of annual natural gas production (million cubic metres) is not statistically different from zero).

$H_1 : a_3 < 0$  (coefficient of annual natural gas production (million cubic metres) is statistically different from zero).

Overall significance of the model;

$H_0 : a_1 = a_2 = a_3 = 0$  (all the parameter estimate are zero)

$H_1 : a_1 \neq a_2 \neq a_3 \neq 0$  (not all the parameter estimate are zero)

These data were analysed using multiple regression module of the SPSS version 16.0 software in order to realize objective (iv) of the study. The four function forms above were fitted for the regression analysis.

## RESULTS AND DISCUSSION

The summary of the regression analysis is shown in Table 4 considering the earlier enumerated model evaluation criteria, Linear functional form (Eq. 2) was chosen out of the four fitted for the analysis.

$$MAC = 17898.43 - 0.007COP - 93.27APC + 3.85NGP$$

$$S.E: (11884.4) (0.018) (187.26) (0.321)$$

$$t\text{- values} : (1.514) (-4.220) (-4.979) (12.001)$$

$$R^2 = 0.799, F^{cal} = 49.88, DW = 1.088$$

Note: MAC is the dependent variable

The high adjusted coefficient of determination (79.9%), the significant of the regression coefficient and the conformity of the algebraic sign with a priori expectations were the criteria used for selecting linear function. The variables of significant regression coefficients are annual crude oil production and annual average price of crude oil per barrel. The model showed that for every one million barrel of crude oil increase in production, the output of major agricultural commodities decreases 0.077 ('000 tonnes). Also every one dollar increase in the annual average price of crude oil per barrel leads to 932.27 ('000 tonnes) reduction in the annual output of major agricultural commodities. The insignificance of annual natural gas coefficient may be attributed to non utilisation of natural gas directly in agricultural production.

This result is in agreement with the relationship between food and energy crises. As the price of crude oil increases, the cost of producing food also increases (increase in cost of petrol, fertilizer and herbicides- by product of petrochemical industry); consequently the



Table 4: Summary of multiple regression analysis result

Independent Variables	Coefficient (T-values)			
	Linear Function (Eq.2)	Cobb-Douglas Function (Eq.3)	Semi – log Function (Eq.4)	Exponential Function (Eq.5)
Constant	17989.43*** (1.514)	-0.682 (0.830)	-498813.11* (-3.927)	10.07 (32.895)*
COP	-0.077* (-4.220)	-0.322*** (-1.635)	10535.66*** (-1.287)	-0.0000209 (-4.431)*
APC	-932.27* (-4.979)	-0.267** (-1.964)	-10677.59** (-1.946)	-0.022 (-4.491)*
NGP	3.85 (0.321)	1.63 (6.330)*	71139.59* (6.856)	0.00008904 (10.765)*
R <sup>2</sup>	0.799	0.526	0.573	0.759
F <sup>cal</sup>	49.88*	14.7	17.539	38.89*
D.W	1.725	0.522	0.483	1.137

Source: Authors computations, Figure in parentheses are t-ratio \*, \*\*, \*\*\*, respectively indicate 1, 5 and 10% level of significance estimated using statically SPSS 16.0. All the tests are onetail ( $Z_{0.01} = 2.33$ ,  $Z_{0.05} = 1.645$  and  $Z_{0.10} = 1.28$ ).

agricultural commodities produced will reduce. Thus, leading to increase in price of few agricultural commodities available in the market. Sharp reduction in production will be more noticeable among the small scale farmers than the medium and large scale farmers because of their poor capital base. This means that a cheap and reliable source of energy is crucial for sustainability of food security.

The R<sup>2</sup> value of 79.9% reveals that annual average price of crude oil; annual crude oil production and annual natural gas production (million cubic metres) explained 79.9% variation in annual output of major agricultural commodities. Furthermore, there is overall significance of the lead equation ( $p < 0.01$ ). This means that not all the parameter estimates are zero; hence, there is a causal relationship between the dependent variable and independent (annual average price of crude oil and annual crude oil production). The Durbin Watson value of 1.73 means that there is no auto-correlation.

### CONCLUSION

The global food and energy crises constitute serious threat to millions of the poor, vulnerable as well as the rich. The food crisis in particular has triggered violent protests around the world in Asia, Africa, Latin America and the Caribbean. The crises have spurred commitments to action from concerned individuals and institutions around the world. This study has shown that output of agricultural commodities is strongly dependent on price of crude oil, crude oil production as well as natural gas output. From this, it is obvious that efficient, affordable, environment friendly source(s) of energy/fuel that is not subject to vagaries of politics and international market prices is germane for sustainable food security. As far as Nigeria is concerned, electricity crisis is more serious than the fuel crisis. Hydroelectricity and thermal electricity have failed. The following options: solar and nuclear energies are suggested for crisis – free electricity required not only for food processing but also for the storage and preservation for surplus and perishable agricultural products, respectively (food availability and utilisation). However, the fear with these options are the size of solar cell that will be required to generate one megawatt of electricity and the problem of disposing waste nuclear material which is radioactive. Moreover, the study also suggests the encouragement of bio-fuels technology in the country to complement fossil fuel and reduce the impact of imported energy crisis (crude oil price increase) in

Nigeria. However, unlike the common bio-fuels extracted from grains, sugarcane and palm oil (this is in order to avoid competition with food requirement), bio-fuels obtained from plant residues and animal wastes, that can minimize land use change, avoid competition for grain with man and avoid some of the emissions associated with certain current bio-fuel programmes. Raw Material Research and Development Council (RMRDC) is expected to play a significant role in this regard as well as in the area of food processing/storage and utilisation. There are various sources of energy/fuel options that possess these aforementioned qualities.

### RECOMMENDATIONS

**The following are recommended to ameliorate intermittent fuel crisis in Nigeria:**

- The old NNPC pipelines laid across the country should as a matter of urgency be replaced with new ones to enhance effective distribution of petroleum products and to protect life and properties of Nigerians that reside some kilometres away.
- Competent firms should be engaged to carry out sustainable turnaround maintenance on the refineries so that our foreign reserve will no longer be spent on imported petroleum products
- Lasting solution should be sought by the government for Niger – delta crisis.
- Frequent increase in pump price of fuel should be avoided by government.
- The following are recommended panacea for food crisis in Nigeria based on this study:
- Government should encourage food production by making sure those necessary infrastructural facilities such as good road, portable water and electricity and hospitals especially in the rural areas to reduce rural – urban migration of potential farm labourers.
- Government should resuscitate agricultural research institutes, extension agents, irrigation facilities at the river basins. Specifically, research institutes should be encouraged to come up with alternative farm inputs to fertiliser, herbicides and pesticides (by-product of petrochemical and natural gas industries) whose prices are subject to changes in global fuel price. Alternatives like green and organic manures.
- In the face of high and rising energy, fertilizer and other input costs, small scale farmers may not be able to maintain current production levels and yields in



the coming growing season. Thus, it is imperative that financial and in-kind support be urgently extended to enable smallholder farmers to expand food production. Governments and donors may want to engage private sector input suppliers in public-private partnerships to ensure timely and affordable supplies of seeds and fertilizers to enable small farmers to prepare for the next planting season. According to Idachaba (1991), small scale farmers accounted for more than 90% of food produced in Nigeria.

- Governments have taken various policy measures to mitigate the impact of higher food prices. Analysis could inform policy interventions and ensure the most cost-effective policy interventions. Governments have used grain reserves, subsidies, price controls and trade restrictions to lower domestic food prices. Some of these measures have implications for the budget, long-term supply and trade conditions. It is essential that confidence in international grain markets be restored in order to curb price increases.
- Dependence on imported grains such as rice that Nigeria has comparative advantage on its production should be discouraged.
- Commercial Banks should improve their commitment to food production in terms of loan extended to genuine farmers.
- Government should urgently complete the construction of grain storage scattered across the country so that excess grain during harvest can be preserved.

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