Causes, Magnitude and Consequences of Price Variability in Agricultural Commodity Market: An African Perspective

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Abstract: In the advent of the African food crisis in 2007, much attention has been focused on the food price variability in Africa in order to restrain the negative effects of price fluctuations. This paper assesses the impact of increased agriculture commodity price variability and instability in developing countries. It also attempts to understand the magnitude of the current situation in terms of the consequences brought about by food price variability, with special attention given to Africa where the largest number of the world's hungry people lives. Using appropriate research methodology, of quantitative macro-scale analysis, which is based on extensive evaluation of secondary data generated from reputable sources, the study found that food prices in Africa has been influenced not by one or two factors but a confluence of events that were previously given less importance in agriculture and rural development planning – unbridled population growth, oil price fluctuations, importation policies, water availability and political instability. Statistically significant result was found in analyzing the impact of water resources on food prices indicating the importance of investment in irrigation to increase the food yield and thus, address the problem of food shortage for the rapidly increasing population. This suggests the need to improve the dominant farming system in Africa to more sustainable practices. The effects of food price variability have been seen to exacerbate the already alarming undernourishment rate and death rate in certain regions in Africa. Increasing government subsidy on imported food could provide immediate solution to the hunger problems in Africa, however, it is recommended to increase government investment on local agriculture in order to bring about food sustainability in Africa in the long run.

Key words: Food shortage, commodity market, hunger, undernourishment in Africa, food productivity, population growth, oil price, importation, water availability, irrigation.

JEL Codes: Q15, Q16, Q18

1. Introduction

The International Monetary Fund (IMF) reported in April 2008 that most of the food riots triggered by the surging prices of food and fuel occurred in developing countries. African Countries with deficit in production of agricultural commodities have been identified to face serious economic challenges because the cost of imports of agricultural commodities is very high and may lead to deficit in balance of payments. Several recent African-focused research triggered by rising global prices of food and other basic commodities indicates that the problem may have taken roots in Africa where food production started its decline ahead of the other regions of the world. This means that while other regions of the world benefits from green revolution, Africa could not meet the food requirements of its people. This paper aims to assess which external factor might have been influencing the prices of food commodities in Africa. The focus of this research is the national macroeconomic causes of the variability in food prices in African nations, and the consequences of these changes in food prices. These are achieved by addressing the following objectives:

1. To assess the magnitude of food price variability in Africa
2. To examine the causes of food price variability and the extent to which these factors affect food prices
3. To evaluate the possible consequences of food price variability in Africa and the magnitude of such consequences.

The paper is divided into 5 sections. The proceeding section discusses the available literature and past studies regarding the paper's topic. Section 3 discuss the methodology of the research conducted in order to adequately address the paper's objectives, section 4, discusses the results of the data analysis, and section 5 provides a conclusion of the studies along with some general recommendations to address the problems faced in Africa regarding agriculture and food prices.

2. Review of literature

Agricultural factors like technology (Moran, 2003), competition for area of arable land (Goodness and Mungatana, 2010), and land development investments (Cochrane, 2004) have been seen to affect the volume of local harvests, thus, affecting the prices of the locally produced food crops. Because of many factors, agricultural harvests and prices are often in variance across different regions. Market factors like differences in supply and demand have also been established to cause price fluctuations in agricultural products (Timmer, 2011). Much attention has been given to the fluctuating food prices in Africa since 2007, when the price hikes have been seen to cause starvation, famine and poverty across a huge percentage of the African population among others (Hojjat, 2009). Several other factors outside the agricultural sector might have been influencing the prices of food commodities in Africa. These possible external causes on a national scale are investigated in the subsequent sections.

2.1 Causes of food price variability

Trade policies and practices

Africa imports grains more than it exports agricultural products (Triki and Affes, 2011). Although some African governments have liberalized trade in agricultural imports, many African nations have government-controlled firms that monopolize the importation of agricultural products. These institutions try to control the price risks by managing the amount of imports; however, they have little to no control over the prices of the commodities being sold in the local market (Katungi., et al 2011). Because of this, the government often faces large budget deficits. According to the arguments of Anderson (2009), subsidizing agricultural development usually causes the decrease in consumer prices. However, the African agriculture, though being the source of existence for more than 80% of African population (Teweldemedhin and Van Schalkwyk, 2010), is in neglect, and is organized inefficiently, giving the local producers no chances for transferring from subsistence farming to commercial farming (Dan-Azumi, 2010; Francis, 2003). There is little agricultural output sold within the state, and there are very low levels of exports conducted by African agricultural producers (Thornton et al., 2010). African governments opt to import the food products to meet the local demand. This becomes an endless cycle wherein the local agriculture does not receive enough subsidies to increase yield, and the government continues to spend more in importing food to feed the population (Tepe et al., 2011). The tariff rates that are set by the developed countries also favor importation in Africa, as opposed to exporting (Swinbank, 2010). This results to massive importation of cheaper agricultural goods. Locally produced food would then have to compete with cheaper imported food, thus, making the commodity prices lower, however, this often drives local farmers out of business due to lack of profit. On the other hand, Pearlberg (2008) argued that importation and international food prices are not to blame for poverty and hunger prevalence in developing countries. He claimed that the imported food market is generally made up of the less poverty-stricken population, while those who are hungry usually depend on the locally produced food. Therefore, it is ultimately the productivity of local farmers that dictate undernourishment rate and not food prices as influenced by importation.

Oil price fluctuations

According to Seck et al (2010) most agricultural machinery and technology depends on petroleum and any increase or decrease in oil prices in the world market could lead to increase in cost of production of agricultural products. Sage (2010) stated that as agricultural production expenditures increase, the profit margin decreases and producers usually incur loses. In addition, the increase in fuel prices would mean the cost of transporting the produce would also increase. This imply that the prices of food in the local market would rise in order to cut loses that the investors and producers incurred in production and transport. On the other hand, Davidson et al (2011) found that oil prices do not have a direct effect on food prices lately, since more countries are now switching to alternative sources of energy. This gave way to another issue of oil and gas prices increases which suggest that there is a growing need for biofuel production as an alternative source of energy which will lead to increased interest by foreign investors to convert more agricultural land allocated for food production into biofuel raw material producing land, reducing interest in food crops (IMF, 2012; Thornton et al.,

2010). Therefore, the change in the petroleum sector has produced a new threat for food and agriculture in Africa, due to the competition in arable land between food and biofuel sources.

Political instability

Many African nations have been perceived as highly corrupt. Government funds and aid from international agencies have been reported to be mismanaged, and the abundant resources of the region exploited by influential groups of people (Transparency International, 2012a). Several propositions that attempt to improve the agricultural sector in Africa are often delayed or cancelled as a result of lack of political strength and responsibility (Thornton et al., 2010). Foreign aid from international groups has also been declining due to the withdrawal of concerned groups because of fear of the funds being corrupted. This often results to lack of funding to support the local agricultural industry. Corruption and lack of transparency in budget allocation for agricultural subsidies have led to many African governments withdrawing the program (Govereh, 2007). In addition, the African governments have tendered to neglect the concept of given stimulus packages for the local agricultural producers (Tepe et al., 2011). Therefore, it is necessary to encourage population's participation in the agricultural production through the reduction of taxes on locally produced products, which will allow price lowering and demand increase (Mitchell, 2010). Also, contingent political instability of the African region has led to mass destruction of agricultural farms and products. As a result, local farmers experience great losses in the production that discourages them from engaging in commercial farming (Eicher and Staatz, 2003). Arezki and Bruckner (2011) have offered a different view as to how political situation and food prices relate. They explained that higher food prices drive most people of low-income countries to riot and demonstrate against the government, thus, increasing the fragility of the state.

Ogboru and Abimiku (n.d.) hypothesized that the high level of corruption has contributed to the emergence of high poverty levels, and to the aggravation of living conditions of Nigerians. They compared the variables of GDP growth, debt stock, capital expenditures, government expenditures on infrastructure, and the employment rate and found that there are positive correlations between all variables except employment. Ogboru and Abimiku's findings indicate that investment in infrastructure is usually connected with the increase of corruption, while the employment rate decreases with the higher corruption indicators. They also found a positive relationship between the type of rule and corruption. Transparency International (2012)a posits that the military rule is associated with higher levels of corruption, which can be certified by the immense expenditures for military defense, 20 times higher than that of Nigeria's neighbors, and 5 times higher than that of other African countries.

Population growth

The United Nations (UN) reported that Africa have the highest population growth in the world (UN, 2012). Africa's population as reported by the UN is about one billion as at 2009 and at the rate that the population in Africa is increasing, the population is estimated to approximately double in 40 years (ibid). Although there are several problems facing the African population in terms of health, social, environmental and political challenges, the population of the continent still surges. Gowing

(2003) stated way back in 2002 that the population growth of Africa has been estimated to be 3% annually, while the food production rate is only about 2.5%, suggesting that the agriculture sector could not keep up with the speed of the growth of the population. This rapid population growth in Africa poses some threats to the agricultural sector (Anim and Mandleni, 2010). One of the problems, that Africa is facing due to the increase in population include the rapid degradation of the environment and the depletion of resources (Sage, 2010), most of the forested areas in Africa are being converted to economic areas or residential areas for settlement. Some of the effects on agricultural sector include soil moisture, decreased fertility, destruction of different crops and animals, and over-utilization of food reserves (Tepe et al., 2011).

Africa's population increase also means increasing demand for food to feed the entire population. This has lead to various steps undertaken by governments in order to feed the people. Such steps include the utilization of genetically modified species of food crops in order to increase food production. However, these species has not been strong enough to endure the changing climate conditions of many regions in Africa, which means that the production rate of African agriculture has not been able to keep up with the rising population. As a result, the government opts to import food products, thus leading to more market competition among locally produced and imported food products (Anim and Mandleni, 2010), which makes the price of food in Africa more volatile. Bloom and Freeman (1986) offered the view that rapid population growth could have a positive effect on productivity and income generation of developing countries, since a higher population would mean that there is an increase in the labor force. However, the authors cautioned that in order for this increase in labor force and population to be accommodated, the capital invested on food production should also be sustained.

Availability of water resources

Water scarcity has always been a problem plaguing the agricultural sector of Africa since about 80% of the African soil is arid or semi-arid, making it unfit for rain-fed agriculture (Tepe et al., 2011). However, despite this problem, investment in irrigation agriculture is still not one of the priorities of some of the governments in African (Tambi et.al., 2004). In fact, less than five percent of the arable land in Africa is irrigated while the rest still relies on rainfall (Borjesson and Tufvesson, 2010). Gowing (2003) proposed that in order to meet the growing demands for food in Africa, water availability has to be increased significantly for the agricultural areas, and water productivity should also be improved, that is, water should be utilized to its full extent in order to maximize the crop yield. Irrigated areas in Africa should be increased to 23% as opposed to the current 5% (ibid). In order to do this, water resources should be readily available for use by the agricultural sector.

Climate change

Climate change has been identified to impact on the agricultural sector for several reasons. According to Houghton (2001), precipitation variability results to varying moisture content of the soil that would not be optimal for the crops that are being cultivated. It can be alleviated by irrigation, however, majority of the African land are not equipped for irrigation (Tepe et al., 2011; FAO, 2012a).

Of the few regions that have irrigation systems, the water supply is also subject to availability, since water supply is also affected by climate change. Lybbert and Sumner (2012) further explained that volume of food harvested is dependent on temperature, since most crops only survive in a specific range of temperature. If current temperatures increase significantly certain species could not withstand this, thus causing a significant decrease in food yield. Another problem being faced by farmers is the negative effects of high carbon dioxide concentration in the atmosphere which have certain effects on some crops that also affect production rate (Houghton, 2001). Climate change has led to a significant decline in the annual agricultural output in Africa due to the decrease in the land acreage under food production and massive destruction of agricultural products. Climate change has contributed to a rapid decline in water availability, thus obstructing agricultural activities. Ground water that is a product of rain water also constantly diminishes in many regions especially in the Sahel region and some parts of east African region. The negative effects of climate change in Africa cover the increase of dry seasons and shortage of rain seasons, worsening of human resources, and decline of intensive agricultural activities (Borjesson and Tufvesson, 2010). In addition, climate change causes manifestation of vector-born diseases and combination of temperature and humidity induces ideal conditions for malaria. The rise of infectious diseases also produces a negative impact on agriculture, since it affects the availability of labor (Adebo and Ayelari, 2011).

Traditional farming systems

Subsistence farming is estimated to be practiced by over 80 per cent of the African population, especially in rural areas due to such circumstances as non-employment, low industrial activity, and urbanization (Dan-Azumi, 2010). The other reason for practicing subsistence farming is population overwhelming (Eicher and Staatz, 2003). Lack of agricultural land as studies show that the majority of the rural families in Africa possess a maximum of two acres makes subsistence farming the most appropriate and spread practice (Gardner et al., 2007). In this method, the population cultivates crops and rears animals for purposes of both domestic consumption and income generation to carter for basic necessities of life. The output of subsistence farming includes crops such as maize, beans, sorghum, millet, cassava, yams, and bananas and animals such as goats, sheep, cattle, pigs, and poultry (Sebopetji and Belete, 2009).

Commercial farming in Africa has faced various challenges that led to a series of challenges making it unsustainable (Thornton et al., 2010). Poverty has been identified as the main factor leading to the slow development of commercial farming (Francis, 2003). Due to the high capital requirements of commercial farming, most of the African communities find it impossible to engage in its practice. Lack of support and empowerment from the government provokes additional obstacles to the expansion of commercial agriculture. High population increase has been a serious threat and barrier to commercial agriculture, since the rapid growth of African population reduces potential agricultural land size (Dan-Azumi, 2010). In addition, commercial farming causes the excessive use of agrochemicals in forms of pesticides and insecticides to protect the crops. The application of inorganic fertilizers served to improve soil nutrients is unsustainable for the environment and is a serious agent for soil and water pollution (Thornton et al., 2010). Moreover, commercial agriculture

leads to unsustainable irrigation that results in exploitation of river water and underground water and damages the environment (Otieno et al., 2009).

Competition for arable land

Bio-fuel production is rapidly taking course in the global platform where Africa is not exempted. According to Mitchell (2010), the issue of renewable energy is becoming a potential substitute and complement of fossil fuel in the context of declining supply of fossil fuel and the ever increasing prices. Thus, the world population has diverted efforts to the production of bio-fuels for industrial and domestic use. According to Tepe, et al (2011), bio-fuels production in Africa has grown considerable within the last 10 years but Borjesson and Tufvesson (2010) have put a doubt on this claim. Lybbert and Sumner (2012) has put forward that the bio-fuel production has reached great popularity not only due to its positive impacts on agriculture and food production, but also to its ability to eliminate atmospheric destruction caused by fossil fuel. Since the issue of maintaining natural resources and environment are of the highest priority in the world today, bio-fuel production is regarded for its use of varied forms of organic matter including charcoal, manure, wood, energy crops, and agricultural forestry and waste (Naylor et al., 2007). The major forms of bio-fuels include bio-ethanol, bio-diesel, bio-gas, bio-methanol, and bio-hydrogen produced from different agricultural commodities (Borjesson and Tufvesson, 2010).

In regard to agriculture, bio-fuel production has been a serious challenge, since it has threatened food production. Due to the global tendency and high incomes received from bio-fuel production, the focus on agriculture and food production has considerably decreased. The situation is strengthened by foreign investors who switched their interest and money to bio-fuel production (Naylor et al., 2007). As a result, many farmers were deprived of huge investments necessary for the production of food crops. In addition, the production of feedstock to support bio-fuels threatens food production because a lot of land that was under food crops is being replaced by feedstock. Though many countries in Africa like Senegal, Mozambique, Tanzania, Zambia, Mali and Kenya have copious amounts of unused land, the production of feedstock is undertaken on the currently used land (Mitchell, 2010). It has been witnessed in the focus on producing Jastropha[1], sugarcane, and sorghum on lands that were under other forms of food crops like wheat, millet, and maize Betru and Kawashima, 2010). Therefore, the long-term deficit in food production has been reinforced by bio-fuel production. The shortage of agricultural employment opportunities makes people involved in the production of bio-fuels, which worsens the food security and price variability of food commodities in Africa.

2.2 Magnitude of food price variability

The prices of basic crops in Africa have been seen to fluctuate heavily in the past years (Seck et al., 2010; FAO, 2012b). This is evidenced by the annual percentage changes of food prices presented in table 1.

[1] Jastropha is a plant that is used as a source of raw material for biofueal and is commonly available in Africa

Table 1. Average crop prices and percentage change in Africa

	Sorghum		Millet		Cassava		Rice		Maize	
	price (USD/tonne)	% change	price (USD/tonne)	% change	price (USD/tonne)	% change	price (USD/tonne)	% change	price (USD/tonne)	% change
1994	163.44	-9.10%	196.05	-12.57%	239.62	-18.59%	235.28	-13.17%	189.65	-9.30%
1995	229.93	40.69%	256.29	30.72%	274.18	14.42%	284.45	20.90%	224.33	18.29%
1996	253.93	10.43%	326.01	27.21%	291.61	6.36%	356.61	25.37%	228.33	1.78%
1997	253.53	-0.16%	284.64	-12.69%	313.43	7.48%	345.84	-3.02%	389.30	70.50%
1998	271.69	7.16%	334.74	17.60%	385.09	22.86%	358.09	3.54%	291.19	-25.20%
1999	225.22	-17.10%	201.39	-39.84%	349.23	-9.31%	290.24	-18.95%	230.77	-20.75%
2000	271.25	20.44%	241.81	20.07%	311.37	-10.84%	259.38	-10.63%	207.43	-10.11%
2001	199.72	-26.37%	261.30	8.06%	307.12	-1.36%	254.54	-1.87%	202.32	-2.47%
2002	211.02	5.66%	267.91	2.53%	282.89	-7.89%	257.20	1.04%	207.59	2.61%
2003	216.30	2.50%	274.54	2.47%	345.75	22.22%	264.42	2.81%	212.35	2.29%
2004	250.00	15.58%	318.19	15.90%	339.25	-1.88%	297.51	12.51%	238.85	12.48%
2005	292.96	17.19%	373.49	17.38%	336.99	-0.66%	341.46	14.77%	263.86	10.47%
2006	292.19	-0.26%	350.32	-6.20%	382.12	13.39%	381.70	11.79%	263.84	-0.01%
2007	314.69	7.70%	370.04	5.63%	438.20	14.68%	434.48	13.83%	304.51	15.42%
2008	375.49	19.32%	449.82	21.56%	425.73	-2.85%	519.48	19.56%	362.07	18.90%
2009	374.68	-0.22%	508.16	12.97%	421.64	-0.96%	565.48	8.86%	347.28	-4.09%

Source: Computed by author from FAOSTAT database

Food price variability has been a considerable aspect for the international agriculture. According to Timmer (2011), there are several factors influencing commodity price variability such as supply limitations, emerging markets, increased demand for commodities, and unrealized potential in the some Countries. The supply of major agricultural commodities has been in gradual decline over the recent past, including major food grains like wheat, rice, and corn (Badiane and Resnick, 2005). Farmers have been affected by different problems that restricted their constraints in supply of the products. For instance, the availability of farm inputs like fertilizer, finance, machinery, seeds and chemicals has been limited in supply (Bosede, 2010). As a result, the rise of the limitations in adequate supply of the products is accompanied by the increase of price variability (Thornton et al., 2010).

2.3 Consequences of food price variability

The effects of these factors are all concerning the level of productivity or the volume of food yield, and the demand for food, this means the prices of food commodities fluctuate along with the increase or decrease in food supply and demand for it. This could not have been all negative for smallholder farmers if more remunerative prices are realized at the farm gate stage and if they were endowed with the capability to respond to any variability in supply and demand. However, higher farm gate prices means farm subsidies, which most African countries can ill-afford. African countries neither possess the financial capability to pour investments in agriculture and adopt and sustain pro-poor policies at the expense of the other sectors of society. Government funding could not shoulder subsidies to improve agriculture production. This means that any investment to improve agriculture yield would only lead to increased food prices in the local market, as a result of the producers' need to earn back their investment in production costs. According to Aksoy and Izik-Dikmelik (2008), the general effect of food price volatility is poverty, which could either be on the side of the poor farmer or on the side of the poor consumer. As a result, either the poor consumers would not be able to afford basic food for subsistence which could result in an increase in undernourishment rate and malnutrition among the population (Anriquez et al., 2010) or the poor farmers would eventually go out of business due to the losses they incur.

According to an estimate by food and agriculture organization (FAO, 2008), 2007 has recorded an additional 24 million people in Africa that are considered undernourished, and this increase was attributed to the rising food prices in the continent. Sub-Saharan Africa has recorded the largest increase during that year, suggesting that the region is very vulnerable to any fluctuations in food prices. The level of rural poverty determines the vulnerability of a region or a nation to food price variability, a high poverty rate would indicate that a large percentage of the population would not be able to afford the necessary food that they need to survive, leading to malnutrition, undernourishment and even other unrelated diseases (Adeniyi et al., 2009). High levels of undernourishment and malnutrition have been reported to impact a particular society greatly in terms of development in the long term, as these undernourished individuals are less likely to achieve their full potential in terms of educational value and productivity (Victora et al., 2008). Even worse, increased undernourishment rate could lead to an increased death rate. Black et al (2008) reported that undernourishment

accounts for one-third of the 8.8 million deaths of children all over the world. In addition to this, many children die or undernourishment due to the weakened immune system and physical body that they are incapable of fighting off common sickness, that would eventually lead to death (UNICEF, 2009). In 2009, thirty one countries were reported to have a child mortality rate of more than 10%, and 30 of which are in the African region (UNICEF, 2011). This is indicative of how dire the hunger situation is in Africa, and how vulnerable the population is for any food price variability.

3. Methodology

This study employs quantitative research methods, using a cross-country analysis for a cross sectional data taken in a single year. The conceptual framework that was used for this research is formulated based on the review of previous similar researches and literature which is presented in figure 1. The independent variables are the factors discussed in the Literature section and they are (1) importation policy, (2) oil prices, (3) political situation, (4) population, and (5) water resources. The dependent variables are (1) food price variability, and the possible consequences of price fluctuations which are (a) prevalence of undernourishment and (b) country death rate. The paper's hypotheses are as follows:

- Tariff rates, oil prices, corruption, population growth, water resources and political stability affect food price variability.
- Confluence of these factors could predict food price variability and
- Food price variability affects undernourishment rate and death rate in Africa.

A purposive sampling was employed wherein a total of 27 African countries were included in the sample, these are the countries with the complete data on all of the variables mentioned above. Since the data analysis is cross-sectional, the data from 2009 was used in the analysis. Data were collected from credible online sources made up of websites and databases of international organizations, namely, World Bank and FAO. The information was collated and analyzed using statistical methods such as Pearson correlation and regression analysis.

The regression model is in the form of: $(y) = a + b_1x_1 + b_2x_2 + \ldots + b_nx_n$

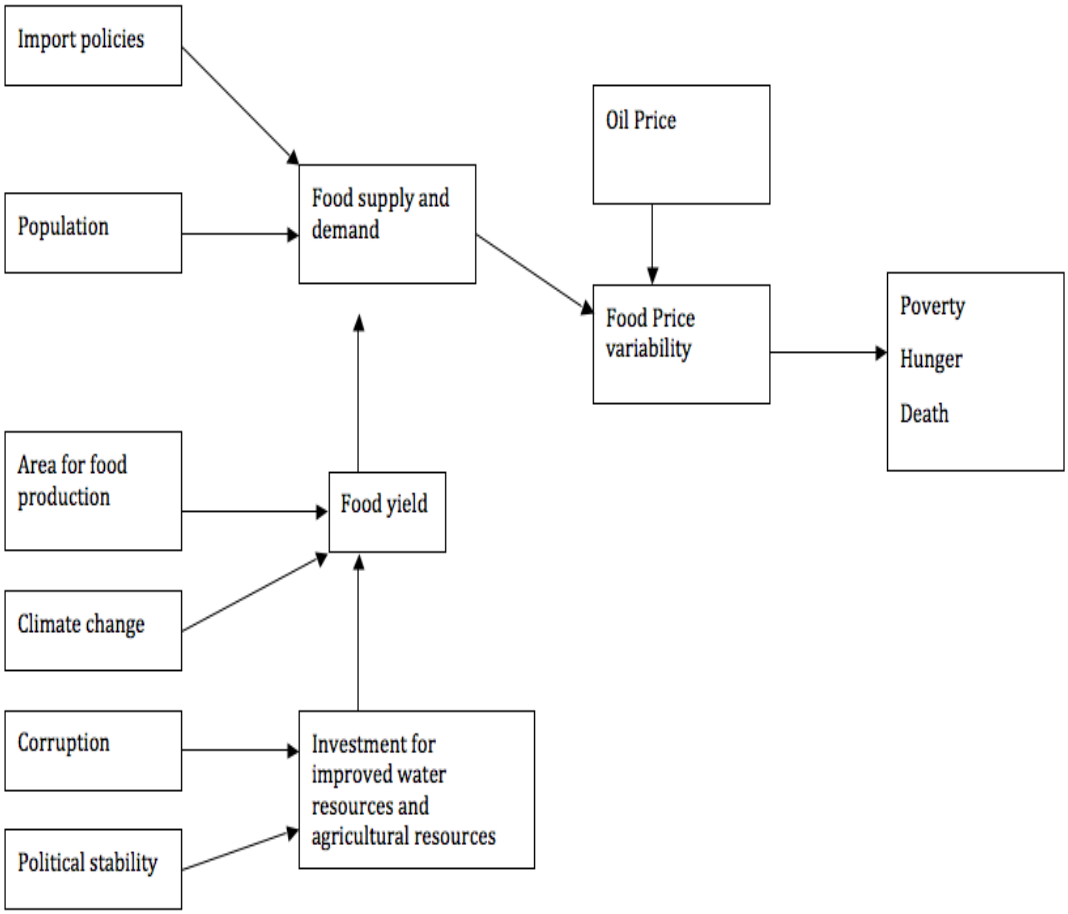
Where y represents each of the independent variables and, is the intercept or the constant, x represents each of the factors that might affect food price variability and b represents the slope or coefficient of each of the factors. The independent variables have been explained to have an effect on the volatility of the food prices across regions, which in turn, affect the financial situation of the poor majority living below poverty line. As poverty increases, hunger and undernourishment would become more prevalent which, when not addresses or treated, would eventually lead to increased in death rate.

Data description

The actual quantitative measures for some of the variables involved in this paper are estimated using the following indicators:

- Import policies (TARIFF) - in order to assess whether the trade policies of the government favors the local farmers and the consumers, the tariff rate was used. This was computed using the weighted mean of the tariff shares of the primary products that are imported. The data source was from the World Bank
- Oil price (OIL) – this is estimated using the pump gas prices in each country, data is expressed in US dollar per liter and the source is the World Bank Database.
- Corruption (CORRUPTION) – to assess the stability of the national governments and the extent to which they are free from corruption, the corruption perceptions index (CPI) of each nation is used. The data is expressed in a scale from 1 through 10, a score close to zero suggests an extremely high level of corruption perception, while a score of 10 indicates that the government is corruption-free. The data is obtained from Transparency International. See corruption perception index in Transparency International (2012b).

Figure 1. Conceptual framework



- Population (POPULATION) – since this data is easily quantifiable, the actual population of each country was collected from the FAO website. The data is expressed in 1000 inhabitants.
- Water resources (WATER) – to measure the availability or scarcity of water in a nation, the water resources data from the FAO website, AQUASTAT was used. The actual total

renewable water resources are used and this was expressed in cubic meters per inhabitant per year.

- Political Stability (POLITICS) – The state fragility index (SFI) published in 2009 was used to measure political stability of each African country. The range is from 0 to 25 wherein a score of 0 indicates a very stable situation, and a score of 25 indicates an extremely fragile situation, see Global Report 2009 in Marshall et al (2009).
- Food price variability – The differences in consumer price food indices of each country was examined for this research, the base year is 2000, with an index of 100, if the index for 2009 is more than 100, this means that the country's food prices have increased since 2000. Data was from FAOSTAT.
- Undernourishment – the prevalence of undernourishment data came from the World Bank database. It is expresses in percentage of the population.
- Death rate – The crude death rate per 1000 people was obtained from the World Bank database to estimate the mortality rate of each country.

4. Analysis of data and results

Magnitude of food price variability

In order to assess the magnitude of the food price variability (FPI) in Africa, the data of the food price index of each of the countries was examined. The data on food price variability is shown in appendix 1.

Table 2. Descriptive statistics of independent variables

	Mean	Std. Deviation	N
Tariff rate, primary products	7.6293	4.42471	27
Pump price gasoline (USD/liter)	1.1630	.39140	27
Corruption Perceptions Index (10= least corrupt)	3.2037	1.05629	27
Total population (1000 inhab)	26976.3704	33252.42716	27
Water resources: total renewable per capita (actual) (m3/inhab/yr)	4208.3630	5288.85729	27
Political Stability (POLITICS) – The state fragility index (SFI)	1756.9456	2311.89668	27

It can be seen that the food prices across Africa have increased since the base year in 2000, as evidenced by the above 100 FPI in all African countries. Sao Tome and Principe has recorded the most Food price increase of almost 1244.87, while most of the other countries have food price indices close to the continent mean of 216.36 (SD = 96.69). This suggests that the food prices in most of the African countries have more than doubled in 2009 since 2000. The extent of food price increases is

more pronounced in some countries compared to the others. This variability might be due to the effects or influences of the independent variables. The data collected on all independent and dependent variables are presented in the Appendix and the descriptive statistics of all of the independent variables are reported in table 2.

Tariff rate and food price variability

The relationship between food price variability and tariff rate is presented in the scatter plot in figure 2. By looking at the graph, a linear relationship could not be easily delineated due to the large amount of scatter. However, it can be inferred that the relationship might be negative, that is, the two variables might be inversely related.

Figure 2. Tariff rate on primary products and food price index

After running a correlation analysis, it was shown that the correlation is indeed negative, but, this was not seen to be significant enough to infer that the variability in the consumer prices is accounted for by the tariff rates, $r(27) = 0\text{-}.003$, $p = 0.494$. This suggests that the effect of the tariff rate policies across the African countries might not be reflected in the food prices. This does not provide support to the current knowledge about how trade policies and importation have an effect on food prices, instead it provides indirect support to Pearlberg's (2008) claim that trade policies and the price of imported commodities do not have a significant impact on nourishment and poverty. This suggests that the market for imported food in Africa are not for the poor, instead, this market is made up of the people who have the spending power. The rural poor of Africa depend greatly on the locally produced food, therefore, policy makers should focus more attention to enhancing local food productivity than in importing goods to meet the requirement of the population.

Oil price and food prices

The relationship between oil price and food price is represented in figure 3. Once again, a possible relationship is difficult to observe from the scatter and the relationship might not be clear.

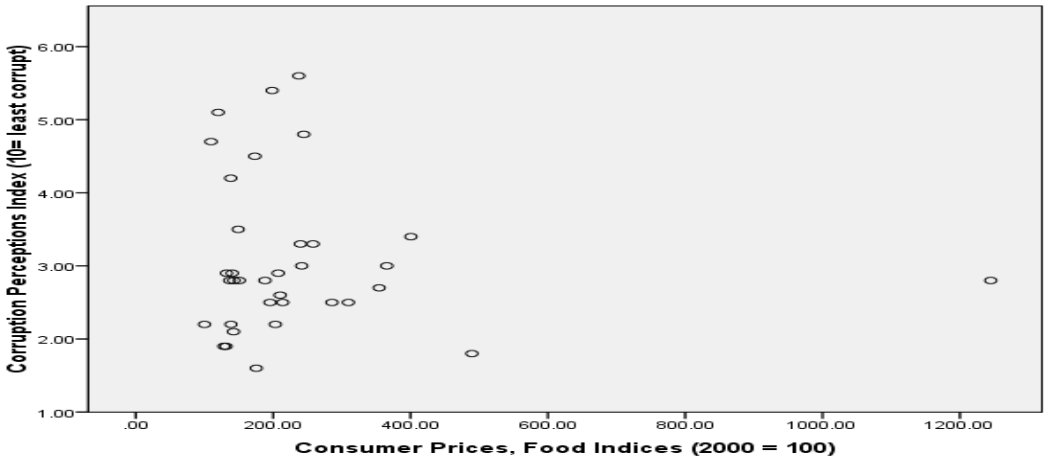
Figure 3. Oil price and FPI

The correlation between the two variables was seen to be negative, suggesting that as pump prices go up, food prices go down, however, this has not been seen to be significant enough to assume that one variable influences the other, $r(27) = -0.176$, $p = 0.191$. This means that the very slight negative correlation is only due to chance. This suggests that the current information about how oil prices impact food prices is no longer as significant as it was before. With the advent of several alternative sources of energy, the prices of basic commodities no longer depend heavily on international oil price (Davidson et al., 2011).

Corruption and FPI

Figure 4 shows the plot of the measures of corruption against food price index. A negative relationship could be inferred by looking at the scatter of the points suggesting that as the government is perceived to be less corrupt, the more likely the food prices are low. This is sensible since the less corrupt a government is, the more funds are available to be allocated to various sectors, agricultural sector included, which would encourage more farmers to continue producing food to meet the demand (Govereh, 2007).

Figure 4. Corruption Perception Index and FPI



Although the correlation test showed that the relationship is indeed inverse, this observation is found to be not significant enough to assume that corruption can account for the variability in food price index, $r(27) = -.251$, $p = .104$. It can be observed that the significance value is close to .1 alpha value, however, it is not enough for the standards set for this research. Further research with wider range of data is recommended to clarify this aspect.

Population and FPI

It can be observed from figure 5, that the total population of the countries is highly variable, however, a possible positive relationship can still be spotted in figure 6, that the more populous nations are more likely to have higher food price index.

Figure 5. Total population and FPI

However, this observation is not supported by the result of the correlation analysis. The correlation, although positive was not significant enough at 90% confidence value, $r(27) = .199$, $p = .16$. Again, the significance value obtain is close to .1 suggesting that there might be a need to investigate this variable's effect on food prices further. This does not reject nor support the prevailing idea that as population increases, food prices become more variable (Anim and Mandleni, 2010). The opposing theory offered by Bloom and Freeman (1986) that an increased population could lead to increased labor force, thus increasing productivity is also not supported not rejected.

Water resources and FPI

The relationship of water resources and food price index is shown in figure 6. It can be observed that there might be a downward trend to the right, suggesting a negative relationship between the two variables, that is, as the availability of water resources decreases, the food price index becomes more likely to be higher.

The correlation study have seen that this relationship is indeed, significant enough to infer that availability of water resources influences the price of food across Africa, $r(27) = .547$, $p = .002$. This means that water resource availability to the population of African nations influences food prices, wherein the countries with more available water resources are more likely to have lower food prices, which could be attributed to higher food supply due to increased food yield, as water becomes more

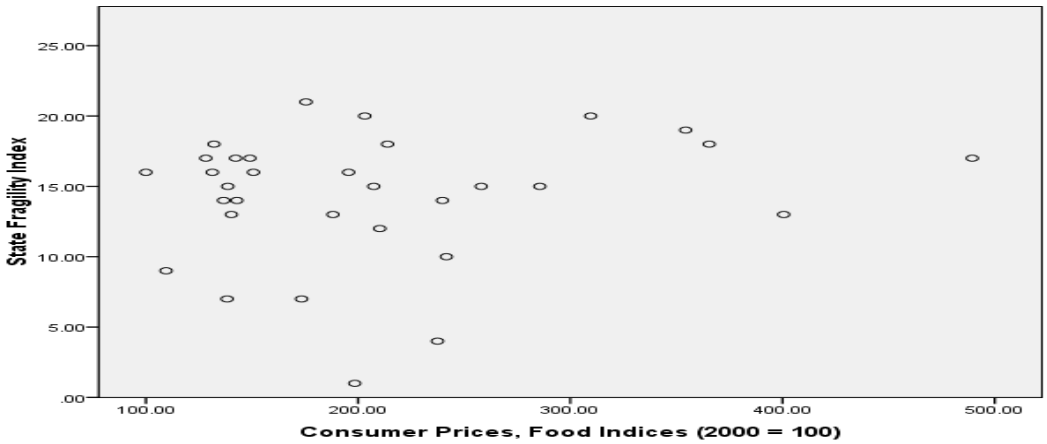
available for the local farmers. As most of previous literature have suggested, the amount of water input to agricultural areas, as affected by climate change and irrigation investments, indeed have a direct effect on food productivity, thus affecting the prices of the crops.

Figure 6. Water resources and FPI

Political Stability and FPI

The mean State fragility index for the countries in Africa is 14.28 (SD = 4.6), suggesting that Africa generally have a serious state fragility situation. The relationship of the political situation to the prices of food in each country is illustrated in figure 7.

Figure 7. State Fragility Index and FPI



It can be observed that there might be a positive relationship between the two variables; the prices of commodities are more likely to be higher in states with higher political instability rating. However, although a positive correlation was indeed found between, this association was not found to be strong or significant enough to assume that SFI has an effect on food prices, $r(32) = .153$ $p = .403$. This suggests that political stability might not have a direct relationship with food price variability and several other factors are at play that has a more significant and direct effect on food pricing. This suggests that theories of Arezki and Bruckner (2011) and Ogbuu (n.d.) about the direct and indirect

relationship between political instability and food prices are not supported by the current results of this paper.

Combined effect of external factors

The relationship of the external variables with food prices has been investigated; however, further analysis is needed to establish the extent to which these factors affect the variability in food price indices of the African countries. Regression analysis is also utilized to come up with a model that would best predict the food price index of the country if the values of the external variables were given. The summary of the regression result is presented in table 3.

Table 3. Regression for FPI coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	-150.251	255.997		-.587	.565
Tariff rate, primary products	1.314	5.201	.060	.253	.803
Pump price gasoline (USD/liter)	-34.120	60.266	-.133	-.566	.578
Corruption Perceptions Index (10= least corrupt)	52.545	39.837	.547	1.319	.204
Total population (1000 inhab)	.000	.001	.143	.444	.663
Water resources: total renewable per capita (actual) (m3/inhab/yr)	.012	.004	.677	2.938	.009
State Fragility Index	11.509	7.132	.586	1.614	.124

a. Dependent Variable: Consumer Prices, Food Indices (2000 = 100)

This model has been seen to predict 27.2% of the variability in the food price index. This suggests that these factors account for more almost a third of the variability in food price index and the remaining percentage might be accounted for by other factors. The model that would best predict FPI in Africa is presented below:

FPI = -150.25 + (1.31) TARIFF + (-34.12) OIL + (52.55) CORRUPTION + (.001) POPULATION + (.012) WATER + (11.51) SFI.

From the result of the regression, the factors that contribute largely on the variability in food price index was seen to be the availability of water resources, this gives an idea of how important irrigation, water supply climate change is among the population, especially to the rural food producers. As water supply becomes more abundant and readily available to the population, the cost of food production decreases, and food yield increases, thus, providing ample supply of food and lowering the prices of food due to market factors.

Corruption and state fragility also account for some variability in food prices; the positive coefficients suggest that as corruption and instability increases, so does the food prices. Fuel prices, tariff rate, and population account for only a small percentage of the variance in FPI, however, this does not suggest that these factors do not matter at all in predicting the FPI. In order to assess the magnitude of the effects of each of these factors in contributing to the changes in food prices, the ranking of the factors is made as as follows based on the regression results as shown above : (1) Water resources, (2) State fragility, (3) corruption, (4) oil price, (5) population, (6) precipitation, (7) tariff rates

Consequences of food price fluctuations

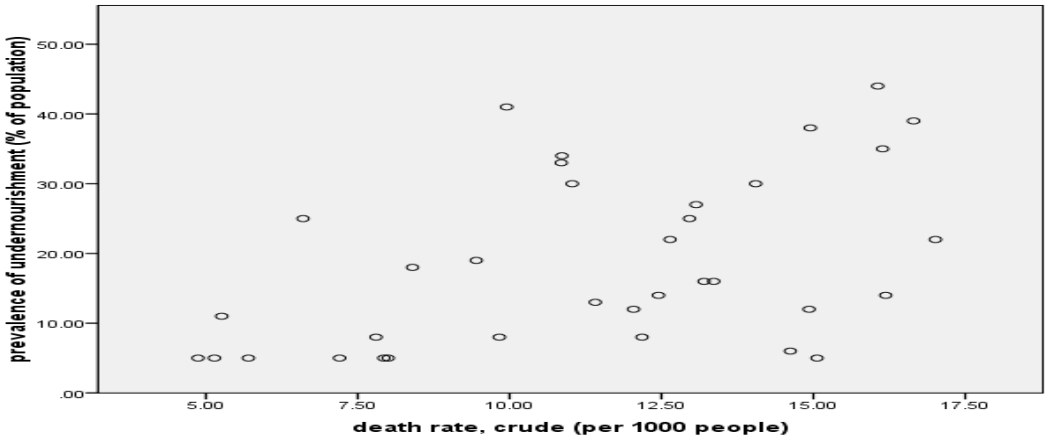
The rate of the prevalence of undernourishment and the death rate of Africa as a whole is summarized by its descriptive statistics in table 4. It can be inferred from the figures that almost 20% of the African population is suffering from hunger and undernourishment, and the crude death rate is 11.26 people out of 1000. These statistics show the magnitude of the dire hunger situation in Africa.

Table 4. Descriptive statistics of undernourishment and death rate in Africa

	Mean	Std. Deviation	N
prevalence of undernourishment (% of population)	19.0741	12.791	27
death rate, crude (per 1000 people)	11.2674	3.68275	27

Figure 8 presents the relationship between undernourishment and death rate across Africa. An apparent increasing trend can be observed from the plots of the two variables indicating that hunger prevalence is a very serious matter that should immediately be addressed due to its fatal results to the population. This relationship has been found to be significant by Pearson correlation, $r(35) = .469$, $p = .004$. Thus, there is a pressing need to solve the hunger problem in many African countries.

Figure 8. Undernourishment prevalence and death rate



A regression analysis was done using the prevalence of undernourishment as the dependent variable to test how each of the external factors affect the hunger situation in Africa. The result of the regression is presented in table 5.

Table 5. Regression analysis for prevalence of undernourishment coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	18.262	32.351		.564	.579
Tariff rate, primary products	-.099	.657	-.034	-.150	.882
Pump price gasoline (USD/liter)	2.923	7.616	.085	.384	.706
Corruption Perceptions Index (10= least corrupt)	-2.797	5.034	-.217	-.555	.585
Total population (1000 inhab)	.000	.000	-.655	-2.161	.044
Water resources: total renewable per capita (actual) (m3/inhab/yr)	.000	.001	-.230	-1.058	.304
State Fragility Index	.358	.901	.136	.397	.696

a. Dependent Variable: prevalence of undernourishment (% of population)

From the results of the regression, population contributes remarkably to the rate of undernourishment in Africa. This model has been seen to predict 35.2% of the variability in the prevalence of undernourishment. Tariff rates, total population and water resources do not seem to have much bearing in predicting the hunger rate of the countries in Africa. Using death rate as the dependent variable, the results of the regression yielded differing results although also significant, as presented in table 6. Both corruption perception and state fragility are also the largest contributing factor to the death rate of each country. This suggests that the high death rate in some African countries might be due to political disturbances rather than hunger and food price variability, and the indirect effect of political situation on death rate of a country is outweighed by the direct effects of power struggle and violence. Other factors that have been seen to significantly affect food prices and hunger rates in Africa were significant in predicting death rate. The model only accounts for 25.6% of the variability in the death rate, suggesting that there might be other factors that were not considered here that affects the death rate of each country. The results of these investigations involving the possible consequences of food price variability revealed that population growth and average precipitation as influenced by climate change are likely to affect the rate of undernourishment and state fragility and corruption affects death rate as these factors also affect the prices of basic commodities that the poor population could not afford, making them more prone to other causes of death like diseases and lack of medication.

Table 6. Regression results for death rate coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-12.463	9.513		-1.310	.207
	Tariff rate, primary products	.109	.193	.136	.565	.579
	Pump price gasoline (USD/liter)	2.837	2.240	.302	1.267	.221
	Corruption Perceptions Index (10= least corrupt)	2.765	1.480	.783	1.868	.078
	Total population (1000 inhab)	-1.644E-5	.000	-.155	-.477	.639
	Water resources: total renewable per capita (actual) (m3/inhab/yr)	8.784E-5	.000	.132	.567	.578
	State Fragility Index	.761	.265	1.055	2.872	.010

a. Dependent Variable: death rate, crude (per 1000 people)

5. Conclusion

The magnitude of the price variability in Africa has been discussed and the extent of the prevalence of its consequences has been shown to be very serious in many regions in Africa. Based on this study, it has been evident that the agricultural commodity price variability has caused a of lot negative challenges in Africa where the food supply from the region cannot sustain the rapidly increasing population. This is because the supply of agricultural commodities has been faced by constraints from economic to environmental factors. Commodity price variability is a negative phenomenon that creates anxiety and uncertainty among African farmers leading to withdrawal from agricultural activities and making unimpressive investments because of fear of making losses or failure of making the much-anticipated profits.

An effect on food price variability was found from the ample water supply, which translates into irrigation of the farmlands. It is recommended that agricultural sector receive adequate investment from the people, because an increase in agricultural investments may lead to surplus production which may lower prices. On the contrary, reductions in funding exacerbate the problem of hunger, undernourishment and mortality rate. The World Bank suggested Africa should not worry about self-sufficiency but focus on export diversification. It should forget about food 'self-sufficiency' and focus instead on 'food security.' In the long run, self-sufficiency in agriculture would definitely help in lowering hunger rates. However, an immediate need to increase food supply and lower food prices in certain regions in Africa is necessary to stop the increasing number of people starving. Subsidizing the produced and imported commodities in order for the prices of food to lower in the local market, so that the poor population could afford them is recommended. A much higher food supply is needed and in order to do encourage importation of food, sound trade policies that would be attractive to foreign exporters should be put in place. However, it is evident that after several decades of low prices and cheap imports, structural evolution of agriculture markets could represent an opportunity

for smallholder farmers and livestock producers in low income, agriculture-based African countries. How this opportunity unfolds will depend on whether appropriate public policies, rural investments and institutional support are put in place to enable poor rural communities to feed themselves and others to satisfy the growing demand of population.

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Appendix 1: Data for dependent and independent variables

	Consumer Prices, Food Indices (2000 = 100)*	death rate, crude (per 1000 people)**	prevalence of undernourishment (% of opulation)**	Tariff rate, primary products**	Pump price gasoline (USD/liter)**	Corruption Perceptions Index (10= least corrupt)***	Total population (1000 inhab)*	SFI+	Water resources: total renewable per capita (actual) (m3/inhab/yr)*
Algeria	150.67	4.87	5.00	7.75	0.3	2.8	34950	16	333.9
Benin, Cotonou	140.3	12.04	12.00	11.68	1	2.9	8602	13	3068
Botswana	237.42	12.96	25.00	1.54	0.9	5.6	1982	4	6176
Burkina Faso, Ouagadougou	149.05	12.18	8.00	7.11	1.4	3.5	15984	17	782
Cape Verde	119.99	5.26	11.00	12.09	1.8	5.1	492		609.8
Chad, N'Djamena	175.44	16.65	39.00	17.21	1.3	1.6	10937	21	3932
Congo, Brazzaville	131.32	11.41	13.00		1.3	1.9	3941	16	211114
Côte d'Ivoire, Abidjan	142.28	12.45	14.00	4.13	1.7	2.1	19350	17	4193
Egypt	188.13	5.14	5.00	6.35	0.5	2.8	79716	13	718.8
Ethiopia	354.38	9.95	41.00	5.55	0.9	2.7	81188	19	1503
Gambia, Banjul	207.39	9.45	19.00	12.76		2.9	1682	15	4756
Ghana	400.55	8.00	5.00	8.88	0.8	3.4	23824	13	2233
Guinea	489.4	13.36	16.00	13.87	1	1.8	9761	17	23153
Guinea-Bissau	128.25	17.01	22.00	10.92		1.9	1484	17	20889
Kenya	138.59	10.85	33.00	8.40	1.3	2.2	39462	15	778
Lesotho	239.74	16.19	14.00	3.53	1	3.3	2149	14	1406
Madagascar	241.62	6.60	25.00	3.34	1.5	3	20124	10	16746
Malawi	258.03	13.07	27.00	8.63	1.7	3.3	14442	15	1197
Mali, Bamako	136.63	14.93	12.00	7.87	1.4	2.8	14910	14	6707
Mauritania	195.53	9.83	8.00		1.2	2.5	3378	16	3375
Mauritius	198.46	7.20	5.00	0.35	1.6	5.4	1292	1	2129
Mozambique	285.61	14.95	38.00	4.37	1.1	2.5	22859	15	9497

Namibia	173.36	8.40	18.00	2.07	1.1	4.5	2242	7	7904
Niger	132.1	13.20	16.00	10.71	1.1	2.9	14972	18	2248
Nigeria	309.61	14.62	6.00	10.13	0.4	2.5	154488	20	1853
Sao Tome and Principe	1244.87	7.93	5.00			2.8	163		13374
Seychelles	244.62	7.80	8.00			4.8	86		
Sierra Leone	203.17	16.14	35.00		0.9	2.2	5739	20	27879
South Africa	109.54	15.06	5.00	1.58	1.2	4.7	49752	9	1005
Togo, Lome	142.91	11.03	30.00	10.41	1.2	2.8	5902	14	2491
Tunisia	138.27	5.70	5.00	11.95	0.9	4.2	10365	7	443.3
Uganda	213.9	12.64	22.00	8.46	1.4	2.5	32368	18	2039
Tanzania	210.22	10.86	34.00	14.94	1.2	2.6	43525	12	2212
Zambia	365.48	16.06	44.00	3.09	1.7	3	12724	18	8268
Zimbabwe	100	14.05	30.00		1.3	2.2	12474	16	1603

Sources: * FAO; **The World Bank; ***Transparency International; +Global Report, 20