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Socioeconomic and Environmental Development of Regions

DIPLOMA THESIS

Agriculture Production and Food Security in Ghana

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The engineers who assisted me when I called on you for help, bravo...”you know yourselves”.

Indeed, I have come to the end of this phase of life not with my strength, To God in whom all knowledge abounds and bestowed.

## Abstract

The aim of the work is to assess the level of agricultural production and food security in Ghana. The methodology used for the work was through the use of qualitative analysis of various researchers. Secondary data was predominantly used as a result of careful applying reasonable data simulation techniques. This work was strictly descriptive in nature. The results noted are numerous, to mention a few, the decline in agriculture labor force which is adversely affecting the country in absolute level terms and relative importance. It is noticed that agriculture production is not having an impact on food security problems. Irrigation facilities for farming is almost nonconformer to agricultural production, even though there is progress in increase of production.

The government needs to balance labor flows within the country. Agricultural Production can be improved through the enhancing and extending the provision of external farming education, fertilizer usage being key to improving agriculture production on yield. In the long term, there is the need on expounding on agrarian politics. The use or adaptation to a good blend of both protectionist and liberal trade policies could be advantageous to Ghana, since they are not a price changer/maker in the globe.

Key words : production, household, accessibility, availability, utilisation, food, poverty, agriculture, nutrition,

## Abstrakt

Cílem práce je posoudit úroveň zemědělské produkce a zajišťování potravin v Ghaně.

Při práci bylo využito metody kvalitativní analýzy od různých výzkumných pracovníků.

Sekundární data byla výsledkem pečlivě uplatněných simulačních technik.

Tato práce má popisný charakter. Zjištěné výsledky jsou četné, např. pokles zemědělské pracovní síly, která má nepříznivý dopad na celou zem z hlediska absolutní výše i relativního hlediska.

Důležitost zemědělské výroby vzhledem k potravinové bezpečnosti země.

Zavlažovací zařízení a jeho význam na zemědělskou produkci v daných podmínkách.

Vláda musí vyvážit pracovní toky uvnitř země. Zemědělská výroba může být zlepšena díky vylepšení a rozšíření, poskytování širšího zemědělského vzdělávání; používání hnojiv je prozatím hlavním klíčem ke zvýšení zemědělských výnosů.

V dlouhodobém horizontu je potřeba věnovat se na vládní úrovni agrární politice. Použití nebo přizpůsobení vhodným kombinacím protekcionistické a liberální obchodní politiky by mohlo být pro Ghanu výhodné.

Klicova slova : výroba, Domácnost, přístupnost, dostupnost, využití, strava , chudoba, zemědělství , výživa Domácnost

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## List of Abbreviations

ADC)	African Development Corporation
ADVANCE	Agricultural Development Value Chain Enhancement Program
AgDPO	Agriculture Development Policy Operation
BUSAC	Business Sector Advocacy Challenge
CIDA	Canadian International Development Agency
CCA	Caucasus and Central Asia
CDD	Center for Democratic Development
CDPF	Cobb Douglass Production Function
CAP	Common Agriculture Policy
CAADP	Comprehensive Africa Agriculture Development Programme
CAS	Country Assistance Strategy
DES	Dietary Energy Supply
DMC	Direct Microbial Conversion
ESDN	European Sustainable Development Network
EMQAP	Export Marketing and Quality Awareness Project
FBO	Farmer Based Organisations
FAO	Food and Agriculture Organisation
FS	Food Security
FDI	Foreign Direct Investment
GCAP	Ghana Commercial Agriculture Project
GEMP	Ghana Environment Management Project
GFDC	Ghana Food Distribution Corporation
GPRS	Ghana Poverty Reduction Strategy
GSGDA	Ghana Shared Growth and Development Agenda
GSSP	Ghana Strategic Support Programm
GOG	Government of Ghana
HH)	Household
IFAD)	International Fund for Agricultural Development
JICA	Japan International Cooperation Agency
LINSA	Learning and Innovation Networks for Sustainable Agriculture
METASIP	Medium Term Agricultural Strategic Implementation Plan
MTEF	Medium Term Expenditure Framework
MOFA	Ministry Of Food And Agriculture, Ghana
MVOCs	Microbial Volatile Organic Compounds
MDG	Millennium Development Goal Achievement
METSS	Monitoring, Evaluation and Technical Support Services

NDRP	Nerica Rice Dissemination Project
NRGP	Northern Rural Growth Programme
OECD	Organisation for Economic Cooperation and Development
RTIMP	Root and Tuber Improvement and Marketing Programme
SME's	Small Scale Enterprises
SPT	Spillman's Production Theory
SAP	Structural Adjustment Program
SFASDEP	Support to the Food and Agriculture Sector Development Policy
Tuberculosis	Tuberculosis
UN DESA	United Nations Department of Economics and Social Affairs
USAID	United States Agency for International Development
WAAPP	West Africa Agricultural Productivity Project
WB	World Bank
WFS	World Food Summit
WHO	World Health Organisation

# 1 INTRODUCTION

## 1.1 Background of the Study

Historically, there are a few studies which have fascinated professionals and academia on the subject of agricultural production and food security. As a result, there is the growing concern to add more theoretical and empirical knowledge to improve and aid the need to resolve major challenges in countries. The role of agricultural production cannot be taken less likely because in many, countries agriculture serves as the backbone of economic growth, food security and the general wellbeing of the people.

There is the other view of why agricultural production is necessary. This raises the issue of 'preference treatment' which is the holding agricultural treatment of a higher nature than other areas of an economy. Thus, the view that agriculture should not be given an extraordinary treatment for an economy likewise the opposite. Clearly, statements such as this represent that of a free market economy. In either case, both views are useful depending on growth and development aspirations of an economy. This is because all sectors of a country deserve equal attention, and needs to be treated with the same level of resourcing power.

One of the most important building blocks of all economies is Agriculture. Thus, it serves as a source of food for people, feed for stock and products for use by industries. This study looks at agricultural production on the application of economic concepts. Also, it serves to add more interesting views on the economic aspects of agricultural production and food security which plays a vital role in economic development. Food is a basic necessity for the existence of life. Food security (FS) is now a new problem which is challenging many economies and is gaining popularity. Initial producers use food security as a tool against the importation of goods. Thus, imported goods have some chemical compositions, were so dangerous in nature and for consumption as well. The understanding of food security has now become a problem of global and regional (national) concern. FS as an operational concept has undergone numerous transformations and transitions and as a result has become complex in nature and technicality.

The World Bank draws (2015) the conclusion that, the world's population is increasing at an alarming rate, this draws attention to the need of securing food for people. While Africa and some other continents population growth and fertility rate are up; other continents have their lowest. The key factor of food insecurity is the issue of unequal distribution in regions or states

or households; this explains the reason why there is so much food in some countries when others have less to eat and are poor, and as a result are food insecure.

There is the need for advancement in policy to look into the needs and have a realistic perspective of how some economies remain marginalized. There is no reason justifiable due to the fact it raises the concern of the vulnerability of all persons living not a single individual in a different location. There is increasing graduate unemployment coupled with a decline in the agricultural labor force of Ghana. Reports from Ghana News agency indicates these among other issues such as the rapid loss of vegetation in the northern part and southern part of Ghana due to either bushfires or unorthodox and illegal farm practices used in monoculture.

From hindsight, the problems to agriculture production and food security in Ghana such as input; farm inputs such as tools, equipment's, fertilizer application and so on, water; irrigation capacity and water accessibility and affordability, may be peripheral.

This study will be of immense additional work done to improve agricultural production and food security issues threatening Ghana. Food security indexes will be viewed through the use of the following indicators; the prevalence of undernourishment, average dietary supply adequacy, domestic food price index, the percentage of children under five years who are underweight.

## **1.2 Aim of the Work**

The aim of the work is to assess the level of agricultural production and food security in Ghana. Some determinants of food production in the country will be investigated. The study will also assess the challenges and prospects of food production and food security in the country. Policy directions will also be assessed.

Finally, some policy recommendations will be made for a sustainable agricultural production and food security in Ghana. The thesis will be elaborated in the structure: Introduction, Literature review, methodology, results and discussions, and finally, conclusions and recommendations.

## 2 LITERATURE REVIEW

### 2.1 Production Theories

**Cobb-Douglass Production Function:** This is perhaps one of the world's famous production function which has been adopted for agriculture production due to its simplicity. The Cobb-Douglass production function was first used in the United States of America, 1928 for the productivity of capital and labor. A common feature is that; the specific corresponding dual cost function can be denied by making use of the first order optimisation conditions along the expansion path. A production function represents the relationship between a combination of factors and output. The initial function had only two inputs, *labor and capital*, both under the assumption that, they were homogenous in degree. The law of diminishing return fascinated the possibility of constant returns to scale. This was chosen on the notion of diminishing returns to each input and constant returns to scale.

Econometric, thus using statistics to estimate economic relationships through science, previously through the use of mechanical calculators in the advent of no computers. The function at that period had 3 functions and they are:

- i. It was homogeneous degree 1 with respect to the input bundle which was consistent with the economics of the day that stressed that the production function for a society should have constant returns to scale.
- ii. The law of variable proportions comes into place as a result of when the function exhibits diminishing marginal returns to either labor or capital, thus when either is treated as fixed input.
- iii. The function was flexible and not rigid, thus could be projected with the respective tools of the day. As a result the two sides of the function could be altered to natural logs in base e or base 10.

Cobb-Douglass estimated labor by using regression analysis, therefore, saved much energy with the calculator by statistical clerks. This function had numerous economic properties of which some were, a simple linear function with a constant marginal product for both inputs. Early generalizations of this function are a summation of parameter inputs to number 1 and allowing for returns to scale of something other than 1.

Another generalization of the function was to expand the function regarding the numbers of inputs as by (Debertin 2012). Assuming the production function is posed as  $PD = PD(L, K)$ , from this, the partial derivative  $\frac{\delta PD}{\delta L}$  is the rate of production changes on labor (marginal production on labor). Whereas  $\frac{\delta PD}{\delta K}$  becomes the change in production with respect to capital (marginal productivity of capital). Thus, the assumptions made are as follows: labor and capital are constants which both will be wiped out if one is absent, and marginal production of labor is of per unit labor, so is capital.

According to Debertin (2012), Cobb-Douglas Production Function (CDPF) is a standardised degree  $\sum D_i$ . Which means that the returns to scale parameter of the coefficient is equal to the sum of  $D$  values on individual input, supposing that all input are treated overtly as available. The  $D$  values signify the elasticity of production on the corresponding input and are constants. The partial parameter is  $D$  values.

Cobb-Douglas theory has come under criticisms; this does not negate Douglas's function to be a perfect fit. There are some demerits to the application of this production function in that: This is an old theory (1899-1922) and admittedly has some problems in current times. Regarding accuracy in different industries and time periods, statistical evidence shows that labor and capital shares of capital were constant over time in developed countries. The explanation was shown using least squares of regression of their production function (Cobb-Douglas). The CDPF was not advanced by knowledge, such as technology and engineering. This was developed because of its mathematical characteristics, i.e. diminishing marginal returns to production. The CDPF fails to test the Micrologic of large-scale processes as in this modern era.

Nevertheless, with the challenges to applying the Cobb-Douglas function, there are some advantages to the use of this theory. These include the listed points elaborated below: The CDPF is a standardised grade of one, covers all types of returns, therefore, generic for application; this takes care of account of a number of parameters; the function is very easy to approximate and free from impractical postulation; and also takes account of raw materials among its inputs.

**Spillman's Production Theory (SPT):** During the 60's, John Kennedy raised the farm issues surrounding the USA. This was termed the farm problem and was a critical concern which drew constructive debates from both sides of policy experts and economists. This is associated



with the area of Agronomy, perhaps the most applicable theory used in Agriculture. This was related to regression analysis. This theory was propounded on the yield of a plant, when managed at different levels of the same application of fertilizer. In Mitscherlich-Spillman's model (1924) there is an explanatory variable, i.e. fertilizer, which depends on the yield of plants. When the plant yield is increased, this turns to increase towards asymptotic behavior whereas the arbitrary variable yield of the plant is almost always held in the same concavity. Debertin (2012), again examines Spillman's function given as:

$$Y = A (1 - R_1^{x_1})(1 - R_2^{x_2}) \quad (1)$$

$A$ ,  $R_1$  and  $R_2$  are parameters to be estimated. The parameters  $R_1$  and  $R_2$  are expected to fall between 0 and 1 and both sum to be less than or equal to one.

$$Y = 1(1 - 0.3^{x_1})(1 - 0.4^{x_2}) \quad (2)$$

Marginal Product of input  $X_1$  ( $MPP_{x_1}$ ) is:

$$\frac{\partial y}{\partial x} = -\ln R_1 (1 - R_2^{x_2}) A R_1^{x_1} < 0 \quad (3)$$

$$(1 - R_2^{x_2}) \ln R_1 < 0 \quad (4)$$

$$\frac{d^2 y}{d x_1^2} = -\ln^2 R_1 (1 - R_2^{x_2}) A R_1^{x_1} < 0 \quad (5)$$

**Production possibilities at society and farm level:** The production possibilities frontier demonstrates the trade-offs in the production of goods. To understand this concept, adopt a situation that technology is fixed with 2 goods  $X$  and  $Y$  which needs resources to be fully used for both. For more of  $Y$  to be produced (resources such as labor and capital) must be also moved from  $X$  to  $Y$  i.e. that the production of more  $Y$  causes  $X$  to be produced.

There are 5 assumptions (held under ideal cases of short run situations not the vice-versa) used in the making of the production possibilities frontier and they are:

1. Two good assume that, there are only agricultural goods and non-agricultural goods in society. This assumption gives the opportunity to use graphs to analyse the trade-offs between goods.
2. Common Resources; holds the view that same resources can be used to produce either of the two goods.

3. Fixed Technology; holds the notion that given full employment, the possibility of increasing output of one good without reducing the output of another product, which is usually the case in the short run. Thus, it is not possible to get more of one good without giving up some of another good.
4. Full employment; the output of one good in resonance to another good at a time 't' given fixed technology will not arise in a decrease of either goods, also usually the same ideal situation of the short run. Thus, it is not feasible to get more of one good without giving up some other good.
5. Fixed Resources; this notion holds an increase in output from the discovery of additional resources.

Alary et al. (2016), on mixed crop-livestock systems, proposed two economically attractive models for biomass with a certain value of livestock production, noting that adoptions of direct microbial conversion (DMC) with cover crops was directly proportional in relation to quality and availability of cover crop biomass as fodder for cattle.

The study then also looks at the view to economies of scale in production (Commercial cash grain hog farms experienced constant returns to scale). Thus, the cost of technological components of medium and large scale farms does not make statistical sense (Wilson, 2016).

## **2.2 Agricultural Production in the World**

Agricultural productivity is important for numerous purposes, of which the three best reasons are for the balance of trade and advancing the food security and health of a country's population. Agriculture output can be assessed in different ways. For example, in tonnage and dollar volume of commodities produced. Both will be looked at; this is because commodities critical to food supply from developing countries are not represented as high-value crops. Bečvářová, Tamáš and Zdráhal (2013), gave a clearer definition for agricultural production. This is briefly said as a "production directly connected to nature, having a broad activity. By what it involves economic and social interests. It contributes to the increase of aesthetic landscape value and in marginal/submarginal conditions; it mitigates tendencies for displacement of regions."

Also, one should note carefully the difference between the volume of production and high-value production. Simpson (2015) asserts that the Netherlands is the leading supplier of tomatoes and chilies, but it is a tiny country. Figure 1 and figure 2 is an illustration of top countries leading in the production of cereals (production in tonnes) and yield. The illustration

shows that the Russia has led production in the year 2014, they produced a little over a hundred million tonnes, twice of Germany's i.e. 4th place in production, followed by France. The Russia has a solid grasp on production looking at their sudden drastic dips in 2010 which production fell to roughly 60, million tonnes making France the lead with a little of 60 million tonnes in production. Also, Canada is the third leading country in the production of cereals. It is, however, interesting to know that in 2009, Germany and Canada tied for 3rd place. France's production is a steady growth, however from 2012, production seems to be nose diving gradually.

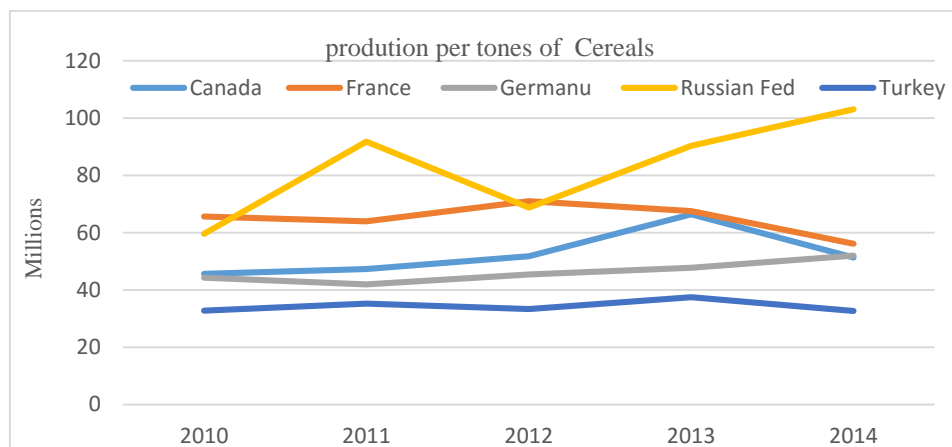


Figure 1. Production per tonnes of major countries leading in cereal production, 2010 to 2014

Source: Authors analysis data from FAO (2016)

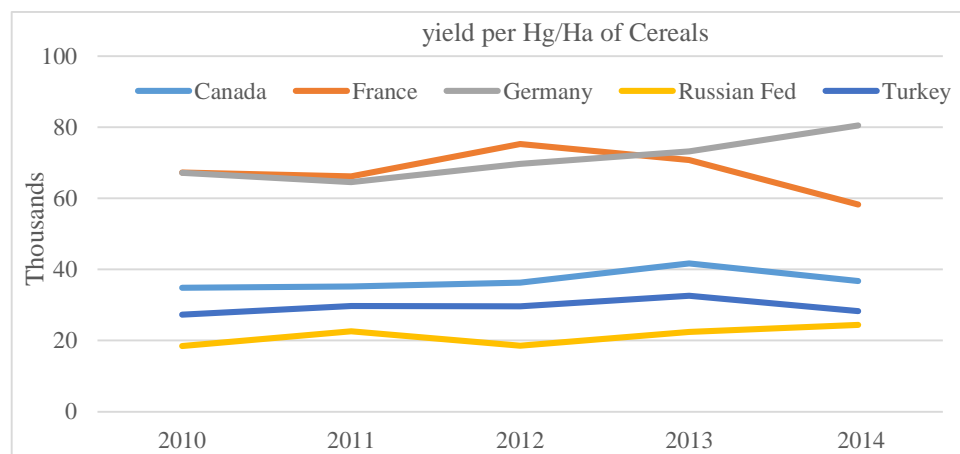


Figure 2. Yield per Hg/Ha of cereals in major selected major producing countries 2010 to 2014

Source: Authors analysis data from FAO (2016)

From the above i.e. figure 2, it explains the yield for the highest producers of cereals worldwide. It can be seen that there may be some factors that influence the yield because even though the Russia has the highest production regarding volume, with yield it was quite the opposite. In

2014, it's noticed that Germany was leading at a little over 80,000 tonnes but was second in production with a little over 52 million tonnes. France, however, was the leading country on the yield of cereals, from 2005 until 2013, when yield had a rapid drop making Germany the leading country regarding yield for cereal cropping.

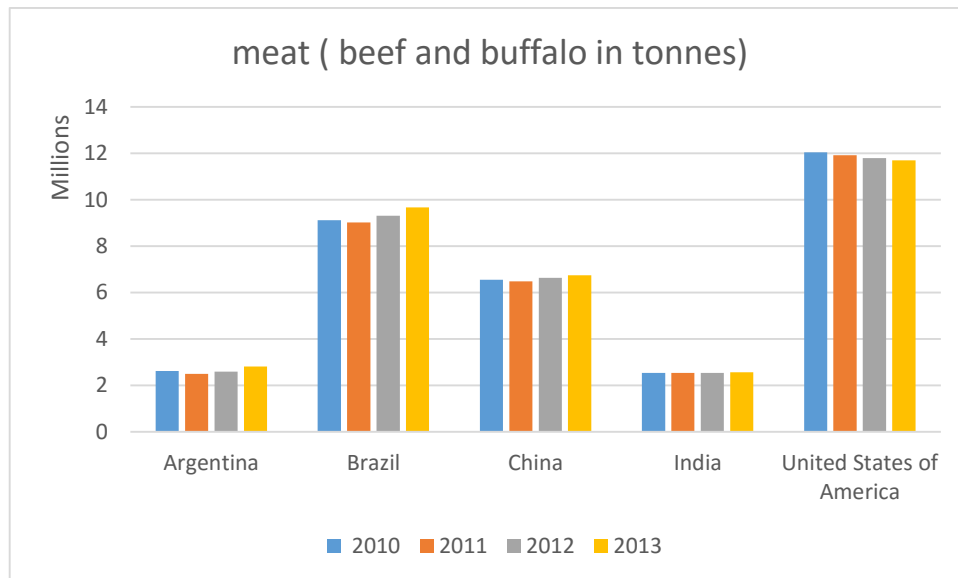


Figure 3. Meat of beef and buffalo production (millions, tonnes) in selected major producing countries, 2010 to 2013

Source: Author's Analysis data from FAO (2016)

Production from the USA was well almost 12 million tonnes in 2010 and well above 11 million in 2011 and 2013 till it fluctuated down a little 11.6 million tonnes as seen in Figure 3. Brazil has a remarkable increase in production, with little over 9 million tonnes in 2010 to around 9.6 million tonnes in 2013. The figure 3, provides insight to some major vegetable producers. This is quite interesting because, all four countries: Spain, India, Italy, USA produced 120 million tonnes between 2010 and 2013. China, on the other hand, produced roughly 550 million tonnes in all 3 within three years, five times more than Spain and Italy. India has shown successful work in steady production growth. Both production record of China and India, may be linked to their population since these two countries have huge populations (current population of China 1.364 billion, and India 1.295 billion, World Bank, 2014).

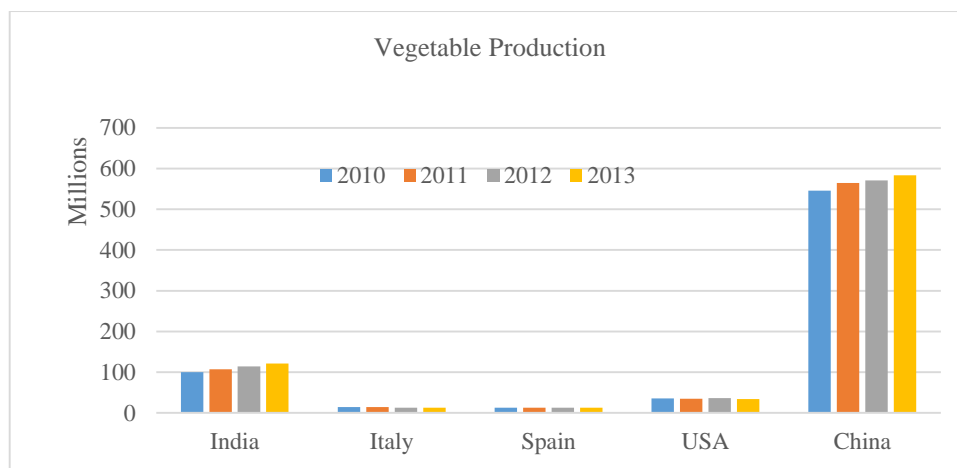


Figure 4. Vegetable production of top countries in tonnes, 2010 to 2013

Source: Authors Analysis data from FAO (2016)

Figure 4 indicates vegetable production and figure 5 yield, although China leads in production with nearly 5.9 million tonnes (2013), while all the countries produce below roughly 12 million, China places 4<sup>th</sup> in yield (closely 240,000 tonnes to that of Spain 360,000 tonnes as highest in 2013). It is interesting to note that although Spain had the highest yield amount in 2013, in this particular year China produced almost six more times than Spain.

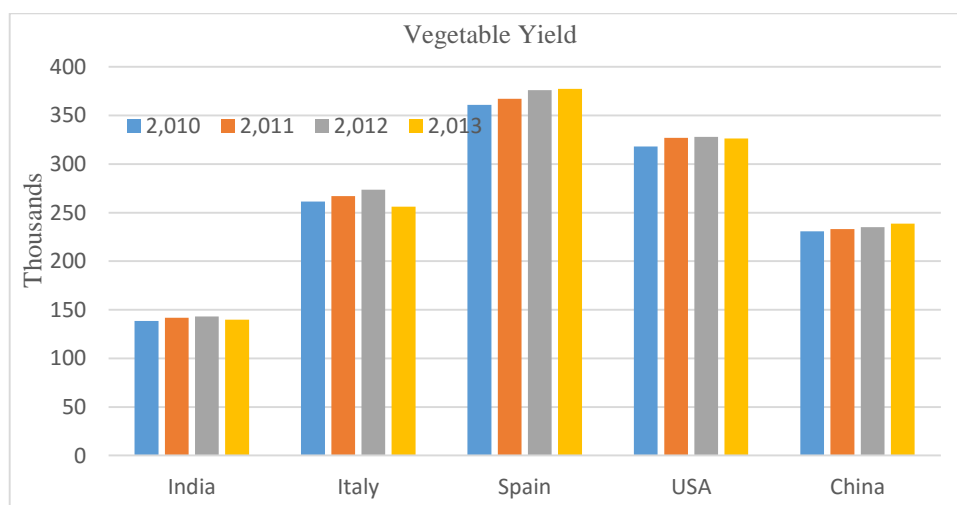


Figure 5. Vegetable Yield of top countries in Hg/Ha

Source: Authors Analysis data from FAO (2016)

Table 1. World's largest fruit producers (tropical freshness, in tonnes, million) 2010 to 2013

World's largest fruit producers	2010	2011	2012
<b>Brazil</b>	0.92	0.92	0.77
<b>China</b>	2.8	2.8	2.8
<b>India</b>	4.4	4.3	4.3

Source: Author's analysis from FAO (2016)

Table 1, shows that India is the biggest producer of fresh tropical fruits, with a production of about four million, three hundred thousand tonnes in both 2011 and 2012 ( production was higher in 2010 by almost one hundred thousand more tonnes i.e. 4.4 million tonnes). China, the second largest producers, had an equal production in all three years from 2010 to 2012. It is noticed from the table that Brazil had barely an increase or drop in output in 2010 and 2011 at which production stood at almost 920,000 tonnes. However, in 2012, production fell to seven hundred and seventy-seven thousand metric tons.

### **2.2.1 Fertilizer Production and Consumption in the World**

Petruj, (2013) points out that, one of the measures to alleviating poverty is through the application of Adam's Smith's theory (the theory of wealthy nations). It is therefore the core mandate for a nation to be able to make fertilizer application a necessary ingredient for agricultural production.

The inculcation of nutrient contents into cropping through fertilizer application is key to high production. The basic and widely used fertilizers for plant nutrition and production are Nitrogen (most important and highest absorbed nutrient), Phosphorus and Phosphate. Nitrogen is needed for the formation of proteins and healthy plant formation before harvesting. Phosphate rock produces phosphorus which is a second most important nutrient for crop/plant growth. This is needed for plants to grow normal so that they can utilize and store energy properly. Potassium, the least of the three, is essentially good for the strengthening of plants/crops to resist diseases and weather condition associated problems, thus preventing wilt. Mullins (2009) states that water quality is one of the greatest concerns for soil needed for agricultural production. Thus, there is the need for a long-term balance between inputs with movements of this to manage the losses of phosphorus in soils as well as excessive phosphorus usage which can lead to water quality problems.

Fertilizer production and importation are looked at by major producing countries who topped cereals for almost 5 years. This is an indication of the nutrient usage to attaining the high level of production. The figure below indicates that, Nitrogen production has been higher for China and India, both producing over 12 million tonnes from 2010 to 2014, with China producing over 27 million tonnes within same period.

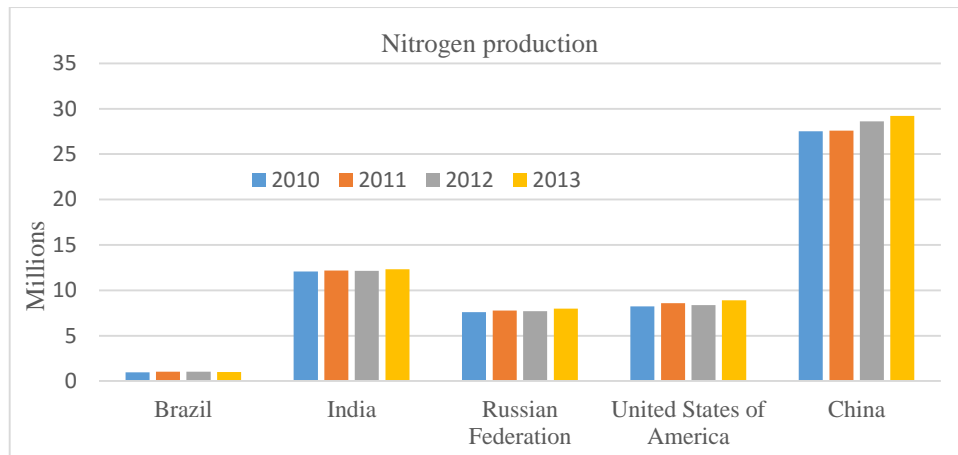


Figure 5. Nitrogen production in tonnes of nutrients for major production countries, 2010 to 2013

Source: Author's analysis based on FAO, (2016)

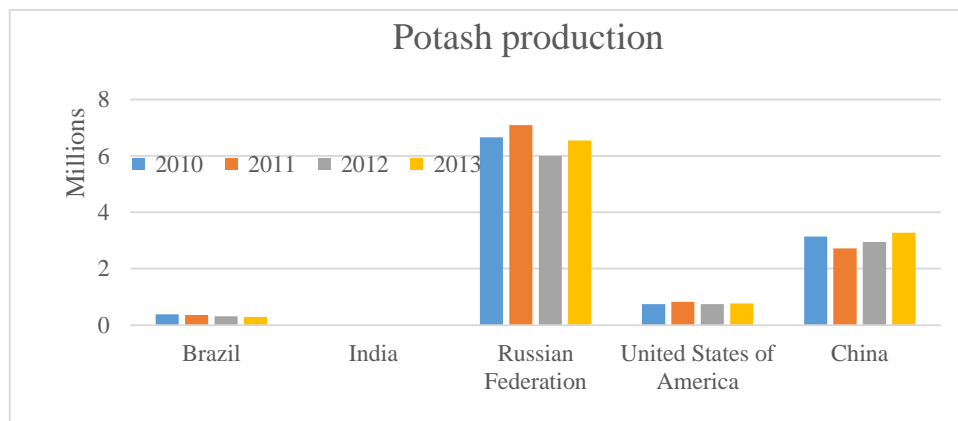


Figure 6. Potash production in tonnes of nutrients major production countries, 2010 to 2013

Source: Author's Analysis data from FAO (2016)

From figure 6, Russia leads almost twice the (production of potash fertilizer) compared to China within 2010 and 2013. In 2012, Russia produced a little over 7 million tonnes of potash as against 2.7 million tonnes of China. It is the opposite with nitrogen production in figure 5 (because figure 5 shows that China leads in the production, 3 times more than Russia) United States of America and Brazil produced in the hundreds of thousands. However, there is an indication that India did not produce Potash fertilizers (an indication of higher importation quantity).

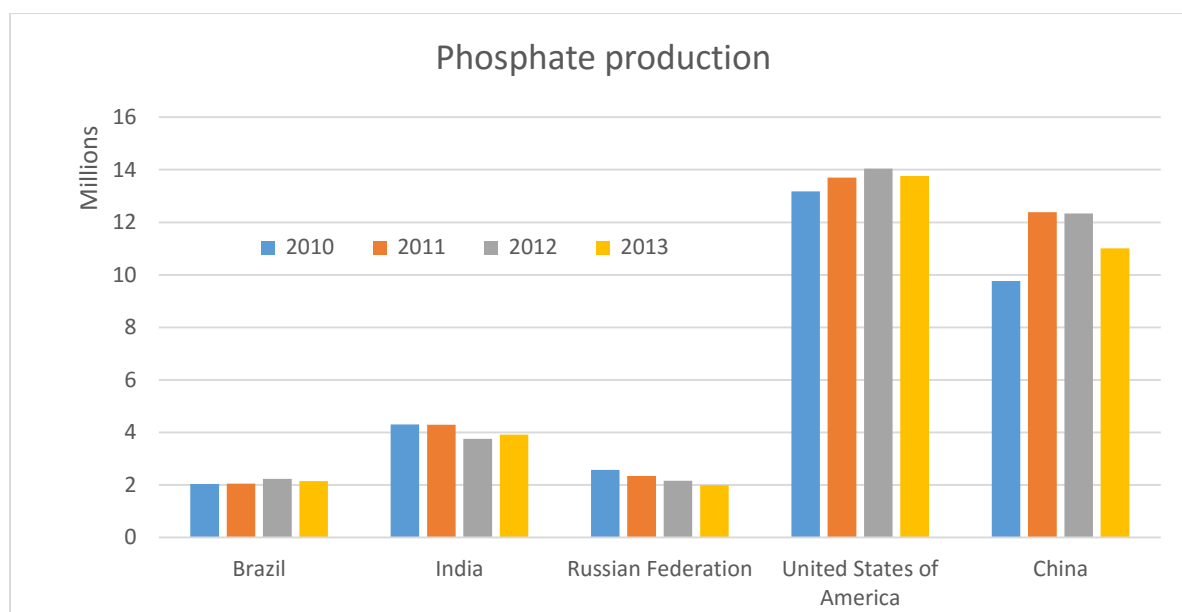


Figure 7. Phosphate production in tonnes of nutrients for major countries, 2010 to 2013

Source: Authors Analysis (2016)

Table 2. Fertilizer Imports in tonnes of nutrients, selected major producing countries

		2010	2011	2012	2013
<b>Brazil</b>	Phosphate	1,515,547	2,245,317	2,265,276	2,711,087
	Nitrogen	2,207,692	2,906,633	2,959,646	3,334,868
	Potash	3,590,346	4,349,180	4,303,415	4,456,319
<b>India</b>	Phosphate	3,698,990	4,057,753	2,762,892	1,573,378
	Nitrogen	4,547,810	5,459,618	4,804,380	3,906,353
	Potash	3,976,190	2,968,935	1,573,100	1,990,990
<b>USA</b>	Phosphate	833,060	1,324,709	1,113,032	1,109,963
	Nitrogen	9,599,261	9,820,115	9,756,187	9,339,377
	Potash	6,172,711	6,451,482	5,155,472	5,846,369
<b>Russia</b>	Phosphate	8,420	11,567	9,452	8,396
	Nitrogen	16,784	16,015	16,512	15,336
	Potash	4,934	11,041	8,859	8,506
<b>China</b>	Phosphate	432,185	266,252	355,472	310,071
	Nitrogen	439,772	332,992	426,270	332,263
	Potash	3,583,446	4,279,554	4,284,666	4,031,537

Source: Authors Analysis data from FAO (2016)<sup>1</sup>

The table 2 (fertilizer imports) and figure 7 above reiterates further that even though, most of the major crop producing countries (cereals) above produce an enormous amount of fertilizer, they again import substantial additional amounts to augment their agricultural production. It is

<sup>1</sup> Fertilizer usage is tremendous in these major producing countries, however it is interesting to note that most African countries do not produce fertilizers and in addition do not import as much as these major producing countries.



seen through out that figure 7 phosphate production is of great importance to agricultural production, so is nitrogen production (figure 5).

### **2.3 Sustainable Agriculture**

World commission on environment and development, WCED (1987) i.e. Brundtland Commission defines Sustainable Development as the development that serves the needs of today's generation and does not place possibilities for their usage by future generations under the threat. This takes note of strong support for agricultural production and social development with keen interest to food security and simultaneously takes the notion of protecting the natural capital of the environment.

Costanza et al. (2009) make it clear that for a sustainable economy, one must respect the economic development with regards the earth's boundaries, recognize the interrelationship between wealth and natural resource existence. Agricultural production is part of wealth creation for economic development; this implies that care must be taken to look at the way the ecosystem is affected by the ability to reach higher agriculture productivity. Chistilin (2010) explains that there is some misunderstanding with the concepts of "development" "sustainability" and sustainable development. Thus, developing the agricultural production sector of a country is not the same as sustainable agriculture.

Brundtland (1987) makes it clear that sustainable development is about exercising limits, not absolute, but through impositions and sanctions on the current state in development with technological approaches and social adaptation on environmental and natural resources which form the basis of natural capital. In a simpler way, this implies that, agriculture production must be carried out with environmental friendly machines and equipment. Also, activities which cause harm to the environment above a certain level or minimum requirement need to be served with some punitive measures, which for example can be the imposition of fines which could serve as a means to averting such practices.

There are 3 fundamental principles of Sustainable development, and they are explained by World Bank (2015) as below: Social: equity, participation, empowerment, social mobility and cultural preservation. Therefore an equal representation of both sexes with the availability of funds as well as maintaining cultural practices that are good enhances agriculture production. Economic: services, household needs, agricultural growth, efficient use of labor. This adds more impetus on agricultural production such as financing, provision of agricultural extension

officers, etc. to aid food security. Environment: biodiversity, natural resources, carrying capacity, ecosystem integrity, clean air, and water. This is key to taking agricultural production and food security into the foreseeable future for generations to come.

Hubert (2011) states, human activities cause harmful threats to the ecosystem due to the catastrophic growth of the world as a whole. The growth rate of human beings and economic activities have doubled or even tripled within the past 20 years, there for the capacity of the earth to hold economic activities for development is fast receding. This is key to agricultural production. Studies have been conducted by numerous bodies concerned such as the Food and Agricultural Organisation, United Nations Department of Economics and Social Affairs (UN DESA), European Sustainable Development Network (ESDN). These studies carried out gives us the notion of the difficulty in transition or moving to a resilient revitalizing economy (for one to attain sustainable agriculture for a country). This is because a prolonged qualitative and the quantitative economic growth of an economy stands to bring dire consequences to the ecosystem as a whole. For swift movement and change to be felt, this needs a different crop of leadership styles.<sup>2</sup>

Miskolci (2014) stresses that protection of the environment is key to a sustainable agricultural production. Taking measures, such as economic, social, organizational and legal aspects in relationship toward the environment, which prevent the effect of manufacturing, consumer and other activities both social and individual on the environment and its components be natural or artificial. There is the considering look on agriculture production and food security with regards to having a sustainable drive. This goes to the largest extent in ensuring an eco-friendly system. Land, water, and other resources for agriculture are finite resources.

According to Atapattu et al. (2011), the need to factor in adequate policy measures to facilitate land management, water management, fertilizer application, female (educating and empowering more) and male farmers inclusive so as to gain a better management of agroecosystems (and non-ecosystems to aid water security and land management and protection). This also entails improved livestock and crop farming with fish management with possible dimension into biodiversity.

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<sup>2</sup> There is the need to adapt to the use of biodegradable substances and recycling of waste to be of immense benefit (through provision of goods and services which comes as a result of agriculture production).

This work also bears the opinion that food consumption patterns have changed over the years. Food production has increased also, and new technologies, and methodologies have been introduced to boost up production. There is more damage to the environment due to this result. Education on food safety, security, nutrition and dependence on sustainable practices to exert a pull on the market is key (Gopalan, 2016). The application of environmental standards is key to reaching this goal. This is important to deter agriculture businesses from going over their limit of pollution.

Blazkova (2013) alluded to this fact that the allowed amount of pollution is in line with social optimum level, however if this level is exceeded, companies must pay a penalty. Thus, the difference between the marginal social cost of production and the marginal private cost of production. Miskolci (2014) again states it is essential for the following to be adhered to for sustainable economy. Protection of the environment must, therefore, identify; the current state which addresses types of pollutants of the environment, sources and concentrations as well as properties. Chistilin (2010) concludes that sustainable economy must be realized due to the economic growth of national production against population upsurge. Agriculture production is of importance as an integral part of national production, food security, growth and national development.

Papadopoulos et al. (2015) indicate that application of organic and integrated farming is important. Also is that most people assumed that common agriculture policy (CAP) supports integrate and organic agriculture through the provision of subsidies. Farmers, however, admit other policy schemes and devalue education as the driving force of embracing alternative forms of agriculture. The changeover from an agricultural regime to a regime built around the ideology of sustainable productions (agriculture) is inherently a complex one. Ingram (2015) indicates that there are a diverse number of linkages in the process runs, also in an overlapping adaptive zone between Learning and Innovation Networks for Sustainable Agriculture (LINSAs) and regime entities. Microbial volatile organic compounds (MVOCs) is perceived as a substitute to the usage of chemicals to safeguard plants from pathogens and gives a setting for better crop welfare, thus can be looked again with keen interest as an eco-friendly, cost effective and sustainable for agricultural practices, that keep soil fertility for a longer period as well as decrease crop production chemical composition (Chidananda et al., 2015).

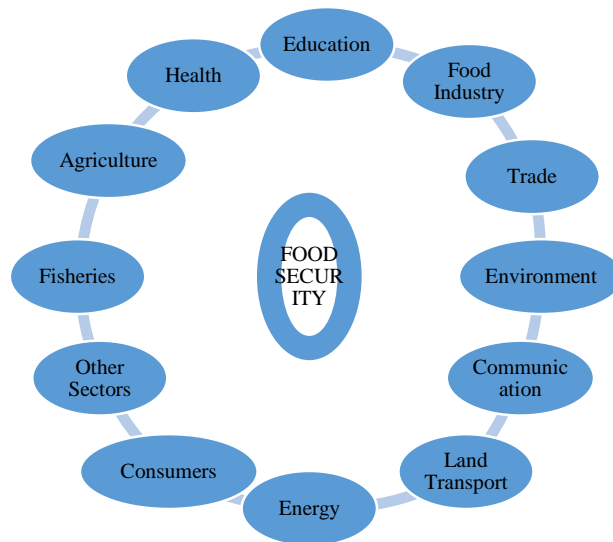


Figure 8. Sustainable food security model

Source: Masaood's (2014) presentation enhanced by author

In all four pillars of the food security model, with the view to the notion that it must be sufficient, nutrition bound, safe and reached at arm's length, there was the need to further improve the pivots surrounding food security on figure 8 Masaood's model (2014). There is the need to improving transportation on land (road constructions, with modes of transports improved), address of energy issues both in food consumption and in terms of crude oil availability to aid transportation and preparation of meals. Also was the need to applying sound environmental practices while improving on agricultural activities.<sup>3</sup>

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<sup>3</sup> For a sustainable economy to be embodied (which makes agriculture a part of sustainable reach) one must acknowledge that the distribution of economic wealth must be based on fairness and equity principles (a view that Constanza shares). Thus, social capital and quality of life must be treated with same mind-sets, same amount of energy must be given to both in terms of application.

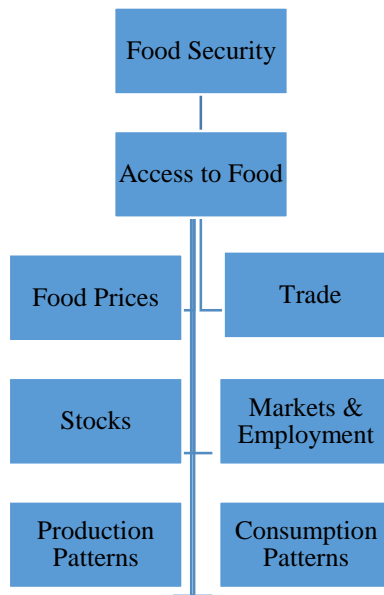


Figure 9. Determinants of Food Access

Source: Author's diagram from the theory of Gilson and Fouad (2015).

From figure 9, food security is of various functions with accessibility as a key. Accessibility is dependent on the factors of food pricing, trade, stocks, markets & employment, production patterns as well as consumption patterns. Production patterns may vary depending on seasonality basis, availability of logistics such as machinery for processing, fertilizer application etc. Consumption pattern is key due to knowing food stock availability and establishing re-order levels for shortages. Applying the law of supply, a price increase in food commodities decreases supply, thus care must be taken to setting price efficiency for maximum utility.

## 2.4 Food Security

This is the prime outcome of a food system is food security. There is hunger and malnutrition coupled with the struggle of nutrient diseases on some people across the globe. The World Bank defines food security as; access by all at all times to enough food for a healthy active life. The UNSCN has a definition which is linked to FAO (1996-2009), which defines it as; *'food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutrition food to meet their dietary needs and food preferences for an active and healthy life.'*

From the world food summit, 4 dimensions: Physical Availability which addresses the supply side of food security; the Access i.e. both economic and physical points of view in relation to

both national and international levels; Food Utilization as the way the body makes the most of the various nutrients in the food (i.e. sufficiency in nutrients, feeding practices). FAO (2015) states that nearly 75% of the genetic diversity of crops have been lost since the last century (1900) as against 32% of livestock breeds which are under threat of extinction within the next 2 decades. Lastly is the stability of the other three caveats over time, even should one have an adequacy of food which does not guarantee food security because other factors play roles, such as unemployment, rising food prices, political instability and adverse weather conditions.

Some governments may defend the importation of some producers even though, laid down structures and policies may not be in favour of public policy (Raghavan, 2006). The freedom and right to function as the leading decentralised supplier of locally adapted seeds has aided India to move from a grain deficient to surplus grain country, should it be even an unwarranted surplus, (Sahai, 2000). Scanlan (2003) reserves that food security is manifested in numerous ways than just with the pillars. The need to take a critical look at the economic, political and social roots of hunger to nutrition based food sources with recognition to population and agronomy approaches. One must however bear in mind that, absolute poverty and inequity are different variables which must not be interchanged. This is due to the fact that comparing similar income groups of a society is a challenge (Petruj, 2013).

Gillson and Fouad (2015) states that policy measures needed for food security are based on 3 notions: firstly, simple structured, stable and predictable trade regimes are necessary components to facilitate food trade that relies on a conducive and flexible way to fulfil border regulations and protocol with a mirror effect on the capabilities of not only farmers but traders also. Secondly, information on regulations and on all protocols that are without difficulty assessable and well known. Thirdly, regulations, procedures and processes for new rules and all protocols that facilitate farmers, traders and governments to contest proposed changes and must give producers time to adjust. This is of greater concern.

Vyas (2016) admits that, even though food system activities pose a force on food security outcomes, these foreclosures are determined by socio-political and environmental drivers. The environmental output of food systems, thus have both stocks of natural capital and ecosystem services, becoming a significant impact on activities on the ecosystems. The pillars of food security are expanded upon below:

### **2.4.1 Availability**

According to FAO (1996), this addresses the supply side of food security and is determined by the level of food production, stock levels, and net trade. World health organisation (WHO) also defines it as sufficient quantities of food available on a consistent basis.

### **2.4.2 Accessibility**

This is due to the adequate supply of food at the national or international level, does not in itself guarantee a household level of food security. Concerns about insufficient food access have resulted in a greater policy focus on incomes, expenditure, markets and prices in achieving food security objectives. WHO defines it as having sufficient resources to obtain foods for a nutritious diet. FAO (1996) defines it as access by individuals to adequate resources entitlements for acquiring appropriate foods for a nutritious diet. Entitlements are defined as the set of all commodity bundles over which a person can establish command given the legal, political, economic and social arrangements of the community in which they live (including traditional rights such as access to common resources).

### **2.4.3 Stability and safety**

This holds the issue concerning the adequacy of food, such that you are still considered insecure if your food is adequate today. You are food insecure if you have access to food on a sporadic basis, risking a deterioration of nutritional status. Adverse weather conditions, political instability, economic factors (unemployment, rising food prices) may have an impact on your food security (WHO, 2015). FAO (2016) states, to be food secure, a population, household or individual must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden (e.g. economic or climatic crisis) shocks or climatic events (e.g. seasonal food insecurity).

### **2.4.4 Utilization**

Most people understand it as the way the body makes the most of the various nutrients in the food. Sufficient energy and nutrition diet intake by households is the result of good care and feeding practices. The food preparation, diversity of the diet and intra-household distribution of food must be key. Combined with the good biological utilization of food consumed, this determines the nutritional status of individuals. WHO clearly makes it as based on knowledge of basic nutrition and care, as well as adequate water and sanitation. FAO (1996) defines it as food through adequate diet, clean water, sanitation and health, care to reach a state of the

nutritional well-being where all physiological needs are met. This brings out the importance of non-food inputs in food security.<sup>4</sup>

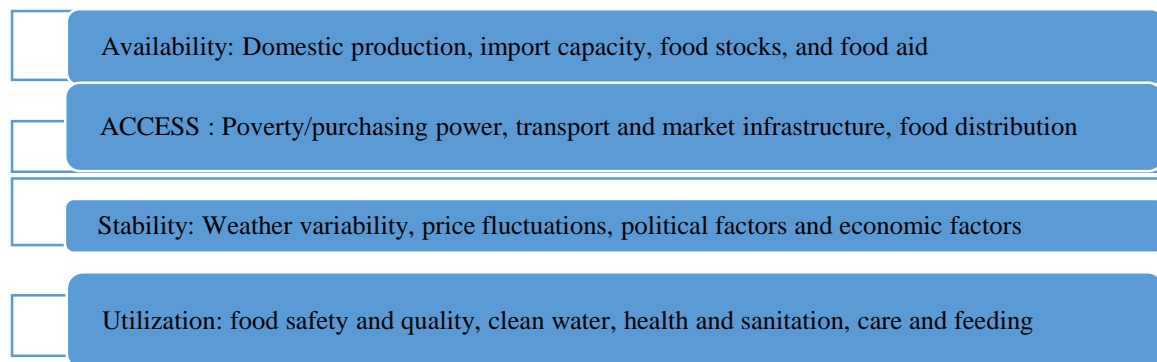


Figure 10. Food Security Pillar Model

Source: WFS, (1996)

The main nutrients of human diet are in three forms; they are carbohydrates, proteins, and lipids. Also, synthetic starch gives the body 50-70% of calories. Also, animals that are reared in the current food industry of modern technology suffer from crowded and unhealthy living conditions. Meat production system brings about high potential of risks from infectious diseases transferred from livestock to human beings such as swine flu, avian flu and hepatitis (Chen and Zang, 2015). Figure 10, illustrates briefly the pillars of food security. It is seen that, utilization is concerned with apply qualitative standards, stability depends on some exogenous factors such as political stability etc.

## 2.5 The State of Food Security in the World

Numerous countries have not been able to achieve the set targets for international hunger. Natural as well as artificial factors such as earthquakes and civil outbreaks have prolonged these countries to reach this stage of food insecurity, not forgetting the increase in growth rate of population.

The World Bank (2015) postulates that nearly 850 million people in the world are underfed. This number has barely changed from 1990 to 1992 based on the World Food Summit and Millennium Development Goal Achievement (MDG) on dropping down hunger by the half of 2015. There is clearly notice that undernourished people decreased from 23.3% 1990-92 to

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<sup>4</sup> This work further looks into some long term drivers of food pricing because it is a factor to be considered before looking into the pillars in totality. Gillson and Fouad (2015) evaluate that food prices respond sturdily to stock-to-use ratios (except rice) and crude oil prices. Other factors are exchange rate movements in a varied manner with some exceptions with regards to interest rates.



12.9 %. Latin America, Central Asia, the Caucasus, the East and South Eastern Asian regions made tremendous progress, so was that of Southern Asia, the Caribbean, Oceania and South and Eastern Africa (marginal or slower pace to get to the MDG 1C target, to halve the proportion of the chronically undernourished or poor). It is also noted that the developing regions had a decline with regards to the MDG 1C indicator, poverty and underweight children under 5 years declined. South-Eastern Asia, South America, and West Africa recorded a faster decline on undernourishment than the rate of child underweight. Thus requiring the need to improve nutrition know-how in diets, hygiene conditions and access to clean water, FAO (2015).

Table 3 shows that, South Asia, Sub-Saharan Africa, and Eastern Asia have hunger challenges with 35.4% (281million people), 27.7% (220 million inhabitants), Eastern Asia 18.3% (145 million inhabitants) respectively with the period 2014-2016. Caucasus and Central Asia (CCA) have made a tremendous improvement to their deteriorating conditions.

*Table 3. Change of distribution of hunger in the world: numbers and shares of undernourished people by region, 1990-92 and 2014-16*

Regions	1990-92 Number (millions )	2014-16 Number (millions )	1990-92 Regional Share %	2014-16 Regional Share %
Developed Regions	20	15	2	1.8
South Asia	176	281	28.8	35.4
Sub Saharan Africa	176	220	17.4	27.7
Eastern Asia	295	145	29.2	18.3
South Eastern Asia	138	61	13.6	7.6
Latin America and Caribbean	66	34	6.5	4.3
Western Asia	8	19	0.8	2.4
Northen Africa	6	4	0.6	0.5
Caucasus and Central Asia	10	6	0.9	0.7
Oceana	1	1	0.1	0.2
Total	1011	795*	100	100

*Source: FAO (2015)*

However, climate change can serve as a catalyst by halving this percentage. Biodiversity, oceans, forests, land and some other forms of natural capital are being depleted at a rapid rate. If care is not taken on food practices and managing of natural capital, food security, especially for the world's poorest will be at risk. Verter and Bečvářová (2014) states that there are two factors that determine food security: supply and demand side factors. The supply factors are those that determine the availability of food while the demand side is based on the stability of food. Every country has its government to play the domineering role on food security. This is undeniable fact which must not be taken aloof. The government's role in ensuring food security

is directly proportional to attaining food availability, accessibility, and stability as well as utilization by all households.

Thus, food security then becomes a public good that is a necessary provision by the government. According to Vyas (2016), there is some low ability to compensating farmer or producers from poor countries.

Diao (2010), states that an important reason for a faster rural poverty reduction and food security at the national level can be due to a higher income emanating from agriculture especially from crop production. Thus, the supply of agriculture production is a feasible poverty reduction measure for rural households living below the poverty line. Diao (2010) identifies that in the rural households in coastal and forest zones, they have extra privileges to involve themselves in non-farm wage employment activities as compared to those who live in savanna zones. Poverty reduction is the result of an outcome of increased incomes coupled with lowering food prices, which is driven by growth in the agricultural base of an economy. This indicates that, households share the profits of agriculture production in lieu to rural and urban incomes moving at comparable rates.<sup>5</sup>

Than and Yapwattanaphun (2015) also suggest that adoption rates, which were high are linked to harvest and post-harvest, cattle management in fields, crop rotation and weed control among others such as the indigenous practice of knowledge. Water availability, supply, and utilisation also play a domineering role because, the 2015 synthesis report by FAO 'Land and water days' makes it clear that sanitation and hygiene practices are keys to which failure brings down nutritional status of people in the form of water born disease and chronic intestinal infections. According to World Health Organisation (WHO) and UNICEF (2015) indicated that 47% of the rural people in Sub-Saharan Africa lacked access to improved drinking water source with 25% not having good sanitation condition in 2012. Political factors were not the only factors that contributed to the improvement in food security. However, a deduction is made by the economist intelligence unit that the countries that made an improvement, achieved that through some factors such as decreased dependence on food safety net programmes, expanded crop storage capacity, lower level of post-harvest loss with increased quality in protein content

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<sup>5</sup> The globe needs to produce fifty percent (50%) extra food according to World Bank in order to feed 9 billion people come 2050. The end of 2015 sparked the end of the millennium development goal targets ( MDG).

substitutes. The trend with higher economies always maintaining their sport did not change. It was alarming to know that 85% of countries in Europe had their food security decline.

From the table below, there is a tremendous difference between the best environment countries and the moderate performing environment countries. This shows that countries that need to improve on their food security situations are worse off. Best environment performing countries have moved beyond the food security ideology to a food sustainability ideology. Thus, affordability, availability, utilization, and stability is not of prime concern since they produce a good percentage of global agricultural products. It is noticed that majority of the worst countries are in the Sub-Saharan African region.

Table 4. Food Security Index 2015, of performances for 10 countries based on 3 different categories

Best Environment Scores 74.2-89		Good Environment Scores 58.5 -74.1		Moderate Environment Scores 41.5- 58.4		Needs Improvement Scores 25.1- 41.4	
USA	89.0	Greece	73.5	Dom. Rep	56.8	Kenya	41.2
Singapore	88.2	Saudi Arabai	72.8	Kazakhstan	56.8	Syria	40.6
Ireland	85.4	Hungary	71.4	Azerbaijan	56.6	Nepal	40.5
Austria	85.1	Slovakia	70.7	Ukraine	56.1	Ethiopia	38.35
Netherlands	85.0	Uruguay	69.4	Ecuador	56.0	Tajikistan	37.4
Switzerland	84.4	Malaysia	69.0	Paraguay	54.5	Bangladesh	37.3
Canada	84.2	Mexico	68.7	Morocco	53.9	Yemen	37.1
Germany	83.9	Brazil	67.4	Sri Lanka	53.7	Sudan	36.5
Australia	83.8	Argentina	67.1	Uzbekistan	53.6	Malawi	35.3
France	83.8	Costa Rica	66.9	Vietnam	53.4	Angola	35.1

Source: Economics Intelligence Unit (2016)

Table 4 is up made best environment, good environment, moderate environment and needs environment (worst scoring environment) as described by economics intelligence unit. In the best performing environment, the first three countries have a 100% in more than four areas with no weakness. United States of America (USA) has the following strengts and scores 100 (a perfect score in 6 areas), whiles Singarpore scores a perfect score in 9 areas.i.e. food consumption as a share of household expenditure, proportion of population under global poverty line, presence of food safety net programmes, access to financing for farmers, public expenditure on agriculture research and development and nutritional standards. It is surprising to know the margin of corruption in the USA is 25% less (75%) this implies, that, there is some level of corruption within this sector (however, things are being done and done well). Singapore scores 100% in the area of corruption and in addition scores 99.9% in consumption as a share of agriculture household expenditure and 99.6% in agriculture import tariffs. Greece,Hungry,

Slovakia and Saudi Arabia are in the good environment scores. One must ask what Greece is doing to improve its food security situation with current financial crisis problems they face. These four good environment performing countries, have at least a perfect score of 100% in four areas of security. It is interesting to note that while Hungary had 50% in corruption, Greece obtained 25% indicating that situations were worse for Greece, but this did not affect the level of their food security challenges. Dominican Republic, Kazakhstan and Azerbaijan were at a tie, with weakness problems in protein nutrient quality, public expenditure on agricultural research and development, corruption, gross domestic product per capita and political stability risk. These scores provided aid to improving food security situations in countries, which means, that, the higher one scores in a specific area, the better results to improving food insecurity.

## **2.5.1 Current Progress of Food Security in Some Selected Region**

### *2.5.1.1 Asia and the Pacific*

**Availability:** According to FAO (2015), dietary energy supply sufficiency rose by closely 20% in Eastern and South Eastern Asia. South Asia and Southwest Pacific sub-region had marginal increment for food supply (per capita). The Green revolution has influenced the output of traditional staple foods, for the reason that demand per person for cereals is not moving up steadily as supposed to, due to change in economic status among issues such as a change in dietary patterns of individuals. From 1990 to 2015 /16 food supplies in Asia and the Pacific have tremendously risen as compared to the population. Thus, offering a situation of more availability of food per person. However, Democratic People Republic of Korea was the only country which had food supplies inadequate to meet per person's normal dietary needs.

**Access;** notwithstanding the fact that, this region attained the MDG-1 target, over 20% of people still are in extreme poverty in some countries, amongst these are, Bangladesh, India, Pakistan and Lao. The proportion of underweight children under the age of 5 was disturbing in a good majority of countries with 11 to 22 of them in Eastern, South-Eastern and Southern Asia. Access was problematic for inhabitants of mountainous areas, remote and small islands, thus making production inbound decrease.

**Stability;** there was good improvement with regards to food supply. From 1992 to 2012 there was a reduction in adverse situations towards food production. Weather condition problems were curbed through increasing the use of irrigation farming (Eastern Asia increased by 55%,

38% to South Eastern and 36% to South Asia). However, Southwest Pacific Island countries had a growth increase of 72% on their 4% arable area under irrigation.<sup>6</sup>

Utilisation: over the past two decades, stunting continues to remain an issue amongst children in all countries, with a rate of 40% in several countries. In Southern Asia, the rate is between 20% to 43%. There is a considerable amount of deficiency in the Asia Pacific region, with regards to micronutrients such as vitamins and minerals. Vitamin A and iron were seriously deficient for aiding situations such as anaemia.

Latin America and the Caribbean; With regards to availability this region has been a provider of almost 10 % of the world's total agricultural production for cereals during the past 25 years indicating that hunger and malnutrition is not due to food non-availability. Increasing food production is mainstream (FAO 2015).

Access: there has been an experience of continuous economic growth which resulted in increasing income, thus reducing the poverty rate in the region. This was due to changes are done on economic policies. Globally there was an economic growth rate of 2.7%. However, this region grew by 3% (remarkable) in 2014, (FAO 2015).

Stability; there has been tremendous progress made in the past two and half decades. However this faces danger by some consequences if care is not taken. Issues such as sustainable use of natural resources, food losses, and waste coupled with natural disasters. These are necessary conditions for a sustained food security over time, because, these systems are geared to meeting food needs of both present and future generations without threatening the environmental, social and economic bases. There is progress to moving to make stability a reality.<sup>7</sup>

#### 2.5.1.2 Africa

Availability: food availability from 1990 to 2014 increased by 12%, with dietary energy supply jumping from 2,138 calories per person in 1990/92 to 2,391 calories per person in 2014. Countries that achieved the MDG-1 C targets from 1990 to 2014 had an increase in their food availability. Countries including Ethiopia, Mozambique had higher percentage increases

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<sup>6</sup> Supplies to some parts of the region was impeded due to natural and manmade courses such as flood/tsunamis, weather change patterns, poor transportation networks and facilities. As at 2013, Oceania achieved the set target MDG- 1 on the issue of accessibility.

<sup>7</sup> Agriculture sector of this region takes food availability higher than demand as such produces for the global markets 58% of worldwide coffee production, 52% of soy, 29% of beef, 22% of poultry and 13% production of maize.

between 30% and 40%. Cameroon, Sao Tome and Principe, Malawi made considerable increases within 25% to 28% during the same period, (FAO 2015).

Agriculture production determines food availability, the first link to food security, there is the need of good agricultural practices which will lead to efficiency and effective use of land and water for continued growth/ sustainability (Darkwa 2013).

Accessibility: According to the World Bank (2015), the number of poor people living under less \$1.25 a day has reduced by 23% in the sub-Saharan Africa region. There are quite a few countries that are on course to meet the goal of halving the rate of people living under the \$1.25/day (1990 to 2015 MDG 1A target). Countries that recorded high economic growth had an increase in food availability (e.g. South Africa FAO, 2015).

Utilisation: in most countries, 3 out of 10 children under the age of 5 years are still stunted in growth. The target is still lower in this region, and it has not reached the set target under the World Health Assembly targets. However countries such as Ghana, Ethiopia and Senegal have made some improvements to steadily reduce stunting growth in the last ten years.

### *2.5.1.3 Europe and Central Asia*

In the 2015 report of FAO, central Asian countries progressed with the level of reduction in the prevalence of hunger. It is interesting to note that both regions above achieved the Millenium Development Goal target by halving the proportion of people with hunger situations. However, countries within Europe and Central Asia developed different strategies to the attainment of food security. Whiles some countries were focusing on food self-sufficiency, others were more liberal to attaining trade systems with enhancement in agricultural development strategies and policies to food security.

Availability; in 1990/92, nearly 10 million people were under hunger within the Europe, Caucasus and Central Asia-Sub region. This figure declined to almost 4 million in 2014, clearly a 40% reduction in hunger, reducing absolute hunger by half to meeting the World Food Summit (WFS) goal of which half of the people lived in Tajikistan. The average caloric level is dependent on the domestic production of food and availability. Food production between 2000 and 2013 increased steadily within the ECA region ( FAO 2015). It is interesting to know that one country in the ECA region attained higher above the minimum daily calories per day (2,500 kcal/person/day). The average available calories per person a day (1800 to 2,200

kcal/person/day) was attained by all countries in the ECA region. Thus attaining a high level of dietary energy supply (DES), as such caloric availability is not a concern in this region, with Tajikistan making an improvement. Georgia, Moldova, and Tajikistan have lowest DES adequacy, scoring lowest. Tajikistan has a food deficit per person per day (2012/14) of 250 kcal/person/day.

Accessibility: the poverty rates over the years from the 1990's to the 2000's have been entirely stable but fairly consistent. Both countries gained progress in improving their poverty eradication throughout the 1990's to 2000's. Kazakhstan (an energy importing country) faced a growing poverty in the 1990's, on the other hand, situations improved in the 2000's with a gradual decrease. There is the issue of difficulty in accessing countries with higher poverty rates with those to hunger problems, because the \$2.5 per capita per day is not a food only poverty line. This is under the assumption that this \$2.5 (international poverty line for ECA) is used by colder countries because of colder temperatures linked with a higher standard of living cost. About 5 countries (from 2010 to 2012) which included Turkmenistan, Kyrgyzstan and Armenia, had an undernourishment level of 5% using the 2011 poverty estimates guide. Georgia and Tajikistan had a poverty level in this same period above 10 percent, FAO (2015).

Utilization; Malnutrition accounted for nearly 18% in 2010 amongst the Caucasus and Central Asia (CCA) countries, this was quite alarming. Azerbaijan, Uzbekistan and Armenia had higher rates of anaemia closer to 35%, while Uzbekistan had 43%. Bulgaria, Moldova, Tajikistan, Georgia, Bosnia and Herzegovina had an anaemia rate between 26 and 28 percent. Also Armenia, Bosnia and Herzegovina, Moldova and Tajikistan had a higher rate of anaemia with pregnant women at around twenty-seven percent. Cyprus and Kyrgyzstan had an alarming rate with women at close to 30%, FAO (2015).

### **3 MATERIALS AND METHODS**

#### **3.1 Sources of Data**

The data used for the work through data mining was predominantly secondary data, generated from external institutions of interest, such as Food and Agricultural Organisation (FAO), United Nations Conference on Trade and Development (UNCTAD), World Bank, Ministry of Food and Agriculture Ghana etc. Also, journal articles, books, industry surveys, domain page websites of parties of interest were used in this study.

There was a careful synthesis of literature review from works published, surveys conducted pertaining this very work being undertaken. Use of both qualitative types of research comes into use due to its nature of reliability of transparency of scientific work carried out by researchers. This study employs descriptive econometric techniques and statistics to analyze some determinants of agricultural production in Ghana. This work is strictly descriptive in nature.

To add to this, the work focused on analyzing issues pertaining issues surrounding agricultural production and food security in Ghana, so as to give further results and feedbacks to researches conducted in this area. The study sought into the direct link as well as the missing link between agricultural production and food security in Ghana. It interesting to note that a country which is having issues with agricultural production just like in some Sub-Saharan African countries is bound to face serious food security problems. This nexus needs to be unraveled for better and improved quality of life for the people of Ghana

#### **3.2 Limitation of the Study**

Most empirical research carried out in Sub-Saharan African countries through quantitative data analysis have impediments which make it cumbersome for assessment. However, future empirical model was spelled below, but is not expounded upon. Too much attention on food security and poverty alleviation issues are looked at in few areas to the neglect of the country at large. Other reasons are institutional bottlenecks which make it inappropriate to obtaining data which is most often being heckled by political institutions. The time frame for the work was in jeopardy due to the fact that, work was carried out simultaneously with course lectures, assignments are exams. Also, the fisheries sector of agricultural production was not included



in this work, due to how broad both aspects of livestock and crop production are and fusing with food security. The work was organized and carried out with own resources albeit unemployment, this indeed was a great challenge. This work will have had added value should it have been supported with ground data from direct contact with agriculture producers and rural folks who are in poverty situations in Ghana.

## 4 RESULTS AND DISCUSSIONS

### 4.1 Ghana Profile

Ghana is one of the 16 countries in West Africa. Formerly this country was called Gold Coast and lies within 4°44'N and 11°11'N and 1°11'E. The Republic of Togo is to the East, Burkina Faso in the North-West and Cote d'Ivoire with the Atlantic Ocean to the south forming a coastline 550km wide. Ghana's drainage system is mostly based on the Lake Volta which is artificially made and the Volta River basin, SRID (2001). According to the World Bank, the Ghana is a lower-middle-level income, GDP at market prices \$38.62 billion, has a population 26.79 million (2014). Poverty headcount ratio is at 24.2% at national poverty lines. The Organisation for Economic Cooperation and Development (OECD), on 6th October 2015 had Ghana to be the 50th member. This is substantial to the attainment of economic growth and economic development as well as sustainable development. From 1980 to 1989, the mean maximum daily rainfall changed from 0.72 mm to 1.16, 61%, from 1990 to 1999 to 1.18mm (63.9%) from 2000 to 2009 an upward movement (Kotei et al., 2013).

In semi-urban areas subsistence and backyard, farming is common practices. This is based on cut and carry forages with the use of household wastes composing of mostly cassava and plantain peels, leftovers of crops and vegetables etc. This system gives fattened rams and bulls for the market especially during festivities mostly of religious nature.

Commercial cattle farming are limited mostly to the coastal savannah zones with diverse management. A few farms belong to para-statal institutions with heads between 1000 and 3000 cattle. This system comparatively is compassionate. Mechanic increases are as a result of the investment, realized effectively and steadily.

There have been limitations to the livestock sector. This is due to constraints such as lack of improved breeding, stock, disease, poor nutrition, inadequate stock water, insufficient capital, high interest on loans. Also disease control of livestock is the dominant factor in the country. Vector diseases are easily transmitted onto one another, therefore, may need pass unhindered into and out of anthrax, tuberculosis (TB), rabies, foot and mouth disease etc. there is also a use of animals for herding, such as cattle over long distances. The socio-economic limitations include high illiteracy rate amongst farmers, the unwillingness to sell farm animals due to communal ownership and culture of people and the lack of requisite machines and equipment.

*Table 5. Socioeconomic indicators Ghana.*

<b>Indicators</b>	
CPI (Feb 2015)	169.2
Inflation (Ghana Statistical Service i.e. GSS ) (Feb 2016)	18.5 %
Industry Producer Price Index, Ghana Statistical Service (GSS Feb 2016)	523.1
Industry Producer Inflation(Ghana Statistical Service)	
GDP (Ghana Statistical Service) 1 <sup>st</sup> Quarter 2015	4.1 %
Income level (World bank 2014)	Low middle
GDP at market prices ,US\$ billion (2014)	38.62
Overall Statistical Capacity (2015)	65.6
IBRD/IDA Operations approved by fiscal year (2015, US\$ millions)	680
Summary of IDA Credits (Feb. 2016, US\$ billions)	3.623
Value lost due to Electricity outage (Feb. 2013)	15.8
Population (in millions)	26.79
Poverty Headcount ration at national level (2012)	24%
Life Expectancy at birth (years, 2014)	61
Gross Enrolment Ratio, primary, both sexes (2014)	106%

*Source: Author's compilation, data from WB and GSS (2016).*

Ghana is a low middle-income country as per Table 5, it also shows that current inflation as at February 2016 was 18.5%. The overall statistical survey proves to be 65% efficient. This indicates that there are serious challenges with the aspects of human capacity. This is key to food security due to the fact that, the more inefficient an economy is with regards to expertise, the more likely there are to be challenged with development. Development is needed in agricultural production so invariably can be affected , looking at the value of loss due to the electricity outage, in February 2013, this was quite serious (at 15%). For work done, there is a loss of profits of this percentage. The lack of human capacity, lack of use of modern technology with lack of electricity which is need by most agricultural producers especially during storage facilities and processing machines become a challenge to pursue farm interests. In 1998, the world bank reports that the aggregate effectiveness of government was 50.2%, this improved to 58.6 in 2006. The effectiveness of government dropped in 2007 from 55.3% to 44.2% in 2014. This clearly indicates that corruption has increased tremendously. With the view to these 3 caveats, agricultural product is at a serious peril on the notion that, accessibility of credit facility and needed government support for agricultural production to help improving food insecurity in Ghana is a challenge.

## **4.2 Agricultural Production in Ghana**

### **4.2.1 Characteristics of Major Staple Crops in Ghana**

The major food crops produced in Ghana are cereals, for example, maize, millet, rice, sorghum. Also, mostly produced and consumed in the country are roots and tubers, such as yams,

cassava, potatoes, cocoyam, and plantain. These crops are eaten with minimal preparation methods which reduce hunger level of people. Vegetables and fruits include pepper, tomato, onions, okra, nuts, oranges, pawpaw, mango, banana, and watermelon. Cereals such as wheat are daily foodstuff as they are consumed on large bases. However, partly due to climatic conditions, and producers' over-reliance of rainfall, annual production fluctuates over time. Some of the major food crops which form an integral part of food production and contributes to food security in Ghana are highlighted below. Paw are high vitamin content fruits which are patronized by Ghanaians from all walks of life. The nutrient content of cassava is also good and traditions in Ghana makes most Ghanaians patronize the eating of cassava and yam due to their nature. As earlier said, some crops in the country are used for festivals, yam being the most common which is celebrated in most parts of the country, (Mensah 2013).

**Yam production:** The figure 22 shows that Nigeria is the highest producer of yam (the top producer of yams in Africa). Production within a period of 34 years shows that Ghana and Nigeria made some improvement with regards to yam production in quantity. However within the period 2009 to 2014, Ghana made an improvement in production between 5% and 7% as against Nigeria that made improvement between 4% and 6% (there was some result of efficiency in production with Ghana). Yam is one of the staple foods in high demand and consumption (locally made food such as Ampesie and Oto are common meals in Ghana) in Ghana due to its high energy content and its low content of fatty acids. It is also a good source for skin protection. Ghana and Nigeria have a rich history with this food crop, both have different festivals countrywide.

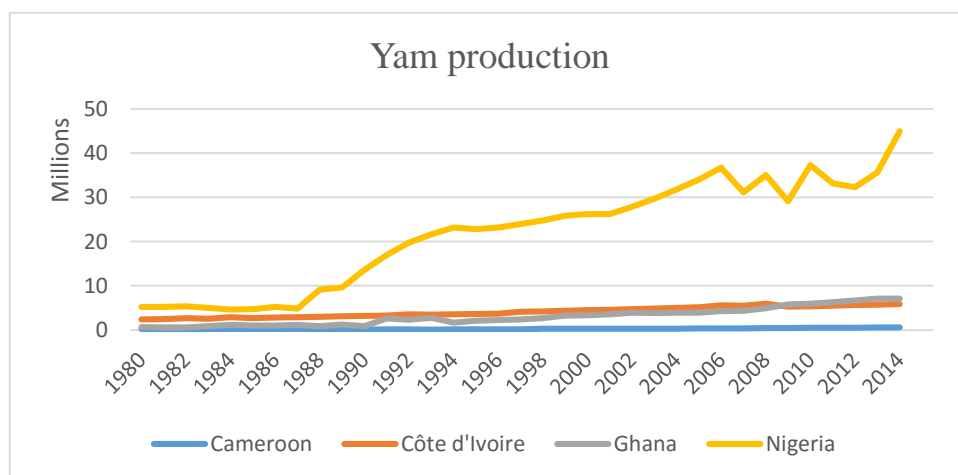


Figure 11 Yam (*dioscorea-Spp*) production in tones, selected countries

Source: Authors analysis data from FAO (2016)

Figure 11 shows yam production some selected major producing African countries. Yam is one of the major exporting crops in the country, serving as a source of foreign exchange and boosting the GDP of the country. The cultivation, producing, processing and transformation of yams amongst other crops such as cassava, plantain, oil palm, oranges and rice springs up employment for the rural folks especially women who are predominantly based in the markets of yam. Yam and cassava are two major commodities also used as raw material for starch in industries and pharmaceutical companies, Zakaria et al (2014). I concur with Armah (2014) on the reasons to investing in yam in Ghana. These include among other factors such as currently good roads, low labor costs, and the politically stable democratic environment. Importation of food is not an issue with regards to cassava, plantain, yam, oil palm and sorghum due to the fact the country was, and is self-sufficient in the production of these. The production of fruits is sufficient and also vegetables, except onions which were largely imported annually especially, for tomato puree which in other ways leads to large volumes of locally produced fresh tomatoes getting rotten annually.

This crop is more limited in areas of the tropics and highly grown and cultivated in West Africa having nearly 90% of global production. Dioscorea was picked by Linne to honor the Greek medico and herbalist Dioscorides who was of the first-century order. There are different types of yam grown and they are namely *Dioscorea alata*, *Dioscorea rotunda* and cayennes. This tuber crop grows very well in the sun and grows from 800mm above sea level. The temperature suitable for cultivation is between 18 ° Celsius and 34 °Celsius. It thrives well in areas with annual rainfall pattern between 1,200 mm and 1300mm (Botanical-online).

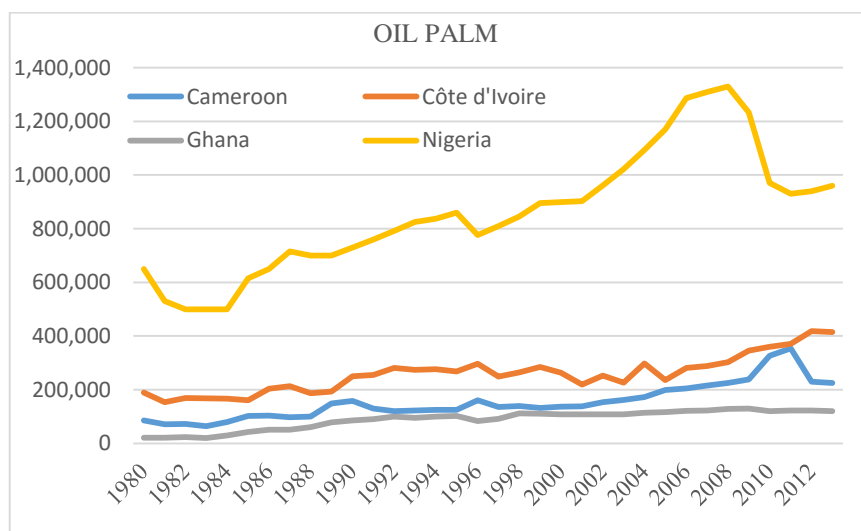


Figure 12. Oil Palm Production Ghana, 1980-2012

Source: Author, Data from FAO (2016).

**Oil Palm** is one of the staple crops in the sub-Saharan African region. Figure 12, shows that Ghana is self-sufficient in the production and usage of this staple crop. This crop is used for many purposes and has great attributes, thus is one of the most liked crops in Ghana. The fruit is used in the production of edible oil and soup (the soup which is eaten with fufu, which is Ghana’s number one favorite food), while the shells are used as a source of fuel (fire) for cooking in locally made pots in rural areas. The nut is used also for generating edible oil as well. In fact, this tree is also used country wide for the making of palm two types of wine called (locally called Nsafufuo and Madoka) and in addition is locally made gin is made from the tree plant. Locally it is referred to with a lot of names depending on which part of the country you stay, some names of this gin are ‘Chief Justice, Lord of Lords, Akpeteshie/Asia, Dabi Meka Masem, Ogogro). The key to this tree is that its cadaver is used, germination and growth of mushrooms. Over the 34 years period, there was a slow improvement of production in both Ghana and Nigeria (an increase within the range of 2% and 4% for Ghana with no decline in production against 2% and 5% for Nigeria with falls to 3% from 2010 to 2014).

Ghana, however, had no drop with regards to production although there was stagnation in production, Nigeria, however, had marginal drop in pin production quantity.

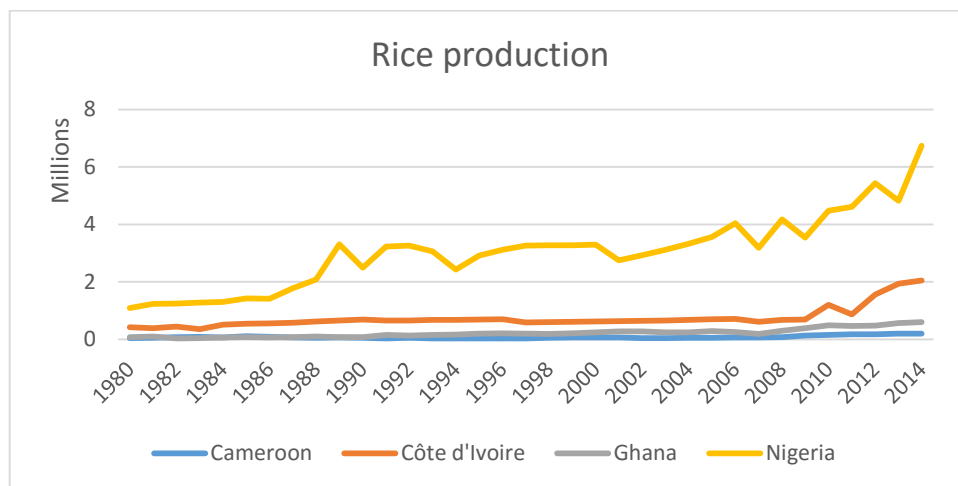


Figure 13. Rice Production Ghana, 1980-2014

Source: Authors Analysis data from FAO (2016)

**Rice production** (figure 13 shows) has been gaining some level of assistance from the government of Ghana due to the difficulty in its production. It is a daily food eaten in most parts of the country. In 1980, Ghana was producing a little over 78,000 tonnes, this production was not drastically increased with a 2 decade period until production increased marginally to

250,000 tonnes in 2006 to 604,000 tonnes in 2014 as against Nigeria’s production of roughly 6.7 million tonnes.

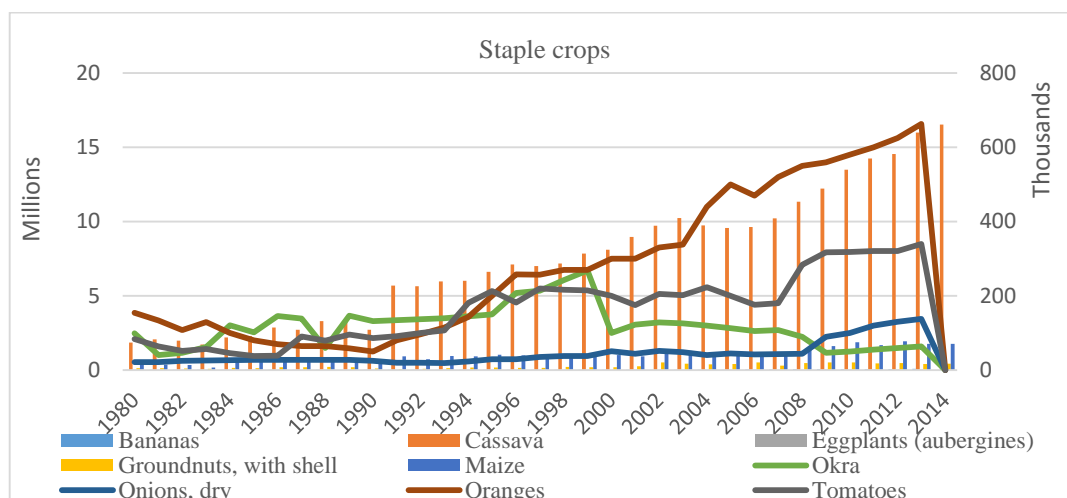


Figure 14. Staple Crops of Ghana, 1980-2014

Source: Author’s Analysis based on FAO (2016)

**Bananas and Oranges** (figure 14) are the most common fruits of high demand and consumed fruits country wide. Cassava is another common stable crop, which is also used purposely for its starch in industrial production and making of fufu, as said earlier above. Eggplants (figure 14), tomatoes, okra vegetable crops are equally of high demand and consumption. Groundnuts, one the most liked leguminous crops is patronized country wide with the cereal crop maize (figure 14).

The table 5 below shows Crop production index has moved higher up with progressive increments throughout the period from 1980 to 2013 from 35.27 to 151.3. There was marginal increment for all countries above, a good indication of improvement. Côte d'Ivoire had the highest index within this period with 217.57 as to Nigeria which had the lowest index of all the countries.

Meat production is not as high as expected due to the fact that, previously Ghana was not a high consumption meat people. This can be ascertained that from 1980 to 1983, production of meat indigenous goat and pig, cattle, chicken and whole fresh milk from a cow was 20,000 tonnes. Production of chicken declined from 1980 to 1986, this also occurred in 2008 (a little above 44,000 tonnes) declining in 2009 (roughly 38,000 tonnes).

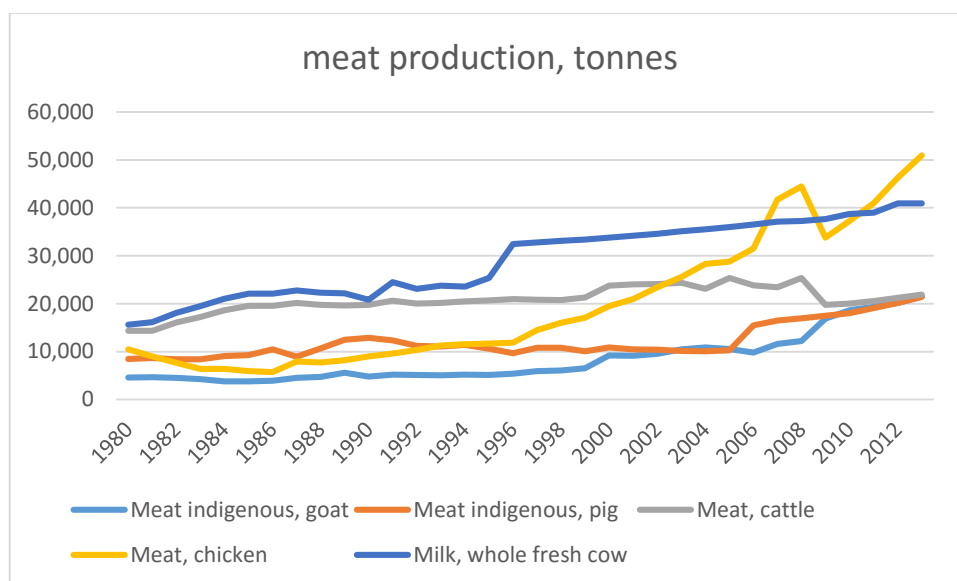


Figure 15. Meat production in tonnes in Ghana, 1980-2012.

Source: Authors' analysis

Table 5. Cereals Production Index from 1980-2013 in Ghana

	1980	1985	1990	1995	2000	2005	2010	2013
<b>Benin</b>	31.53	47.95	49.83	66.32	92.03	108.21	127.31	164.63
<b>Burkina Faso</b>	31.41	47.48	44.93	68.89	68.48	106.79	135.23	143.24
<b>Côte d'Ivoire</b>	60.46	76.5	90.84	95.07	90.44	100.66	149.25	217.57
<b>Gabon</b>	33.31	39.97	69.85	86.15	79.66	106.5	127.06	138.19
<b>Ghana</b>	35.27	46.9	42.96	93.56	91.02	103.66	156.21	151.3
<b>Nigeria</b>	29.95	44.85	66.78	83.91	82.3	98.65	94.86	102.32

Source: Author, analysis.

#### 4.2.2 Major Farm Inputs

The agriculture input dealerships in Ghana are dominated and managed/owned by men. Krausova and Banful (2010) in their discussion paper concerning agriculture inputs sector of Ghana, came out with these investigations; there is a vast difference between the levels of education with farmers in the northern sector of Ghana as compared to those in the southern sector of the country. Brong Ahafo and Ashanti region input enterprises possess good years of education averagely. Input enterprises are less than a decade old, meaning an infant sector, however, seed and fertilizer wholesalers have been on average the longest in the system for about 10.8 years. It is known also that chemical wholesalers are the recent new entrants with at most 4 years in existence.



They, however, state that agricultural input dealer survey was the first of its kind to be conducted so information on of exit input dealers before 2009 was not available. However, feedback was given within a three spanning between a year's periods 2007 to 2009 among enterprises that were dealing in all 3 years Krausova and Banful (2010) .Diao and Quinones (2011) in their thorough descriptive investigation nationwide on the “Ghana Living standards survey” , using information derived purposefully for agricultural production and agricultural transformation , accessed some inputs such as hired labor, agriculture credit, seed purchasing, inorganic fertilizers, rented equipment, transport mechanisms rented amongst others such as storage facilities, irrigation and owned mechanism. It was noted in their survey that agriculture out of a household number of 382, 8% got agriculture credit. With that of storage, out of a household (HH) number of 119, 3% had access, for rented transport of HH number 301, 7% used this input. It is quite surprising that out of HH number of 981 only 19% used inorganic fertilizer. , while 7% used organic fertilizer out of HH 341. Diao and Quinones (2010) excluded handheld tool expenditure because these were capital inputs.

As earlier on said, there is a handicap in this area of nutrient substitutes needed for aiding agricultural production. While major agriculture producing countries, use higher quantities of fertilizer during the growth of plants/crops (that, they also produce fertilizers internally), it is quite sad to note that most African countries do not produce fertilizers internally, but depend highly on imports which are at a higher cost for production turnover. A summary of major plant nutrient of the big three (nitrogen, phosphorus and potassium) is expatiated upon to see how Ghana fares with the usage of fertilizer for the benefit of agriculture production (importation and consumption of these nutrients were synonymous to each other).

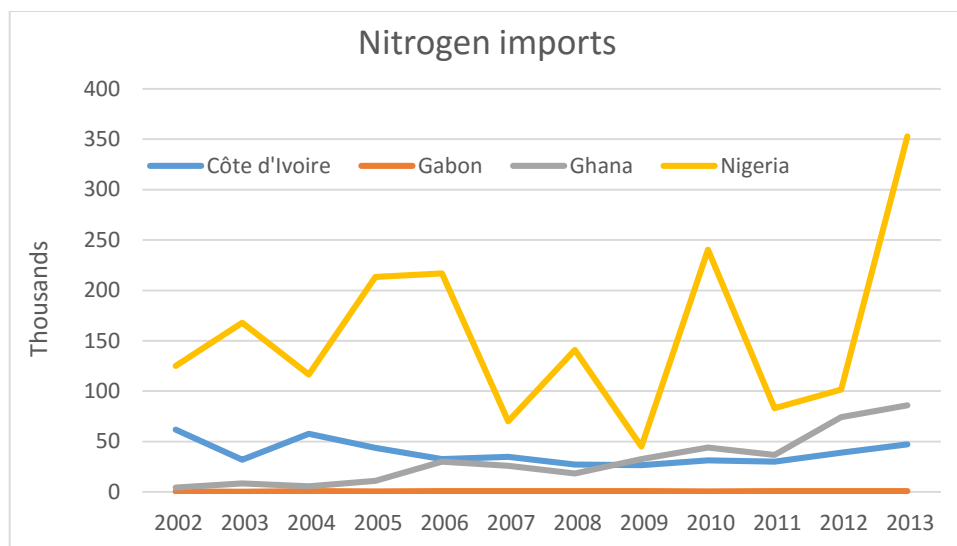


Figure 16. Nitrogen Imports in nutrients of tonnes, 2002 to 2013, in Ghana and some selected countries

Source: Author's analysis data from FAO (2016).

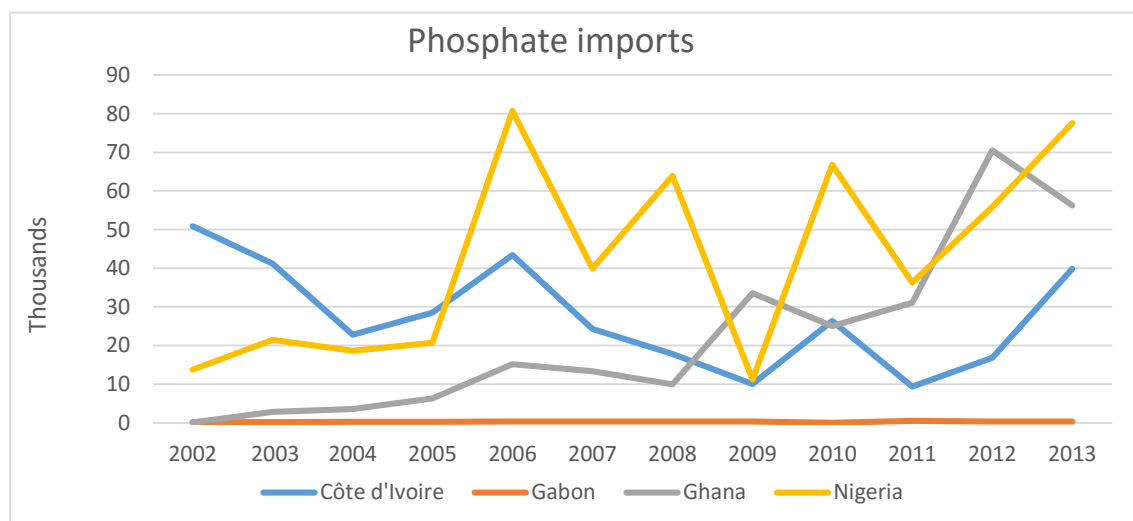


Figure 17. Phosphate Imports in Ghana and some selected countries, in tonne, 2002 to 2013

Source: Author's analysis, data from FAO (2016)

From figure 16, throughout the period of a decade, it can be deduced that Ghana and Gabon had low imports of nitrogen fertilizer. The situation however improved for Ghana when importation was increased from a little over 4 thousand tons to 86 thousand tons (2002 to 2013). Although Nigeria's transgression of imports was high, with imports a little over 125 thousand tons to over a quarter of a million tones (2002 to 2013). Ghana had an increase of 23% as against Nigeria which had 19% increase within the 11 years period (figure 16).

Over the 11 year period (2002 to 2013), there was a marginal improvement to phosphate importation (figure 17) with regards to Ghana even though there were some falls in nutrient

quantity, this was not as high compared to Nitrogen and potash fertilizers. Ghana had made between 1% to 4% increase in importation from 2002 to 2008 as against Gabon that had made improvement between 4% and 9% increase in potash importation (despite the fact that, amongst all 4 countries its importation was lowest). Refer to appendix 1 and 2 for geographical maps with relevant allocations to the various villages, towns and cities.

Figure 18 depicts that, in 2004 Ghana was the highest importer of potash (in the preceding year there was a sharp decline to a little over 6,500 tonnes), with a total quantity of roughly 43,500 tonnes as against Cote d'Ivoire's 41,910 thousand tonnes (holding that this country was the highest importer in 2002 and 2003). There was some amount of improvement to an importation of potash from 2006 to 2013. Within the 11 years period, Ghana made an improvement of roughly 13% increase as against 10% for both Côte d'Ivoire and Nigeria (2002 to 2013).

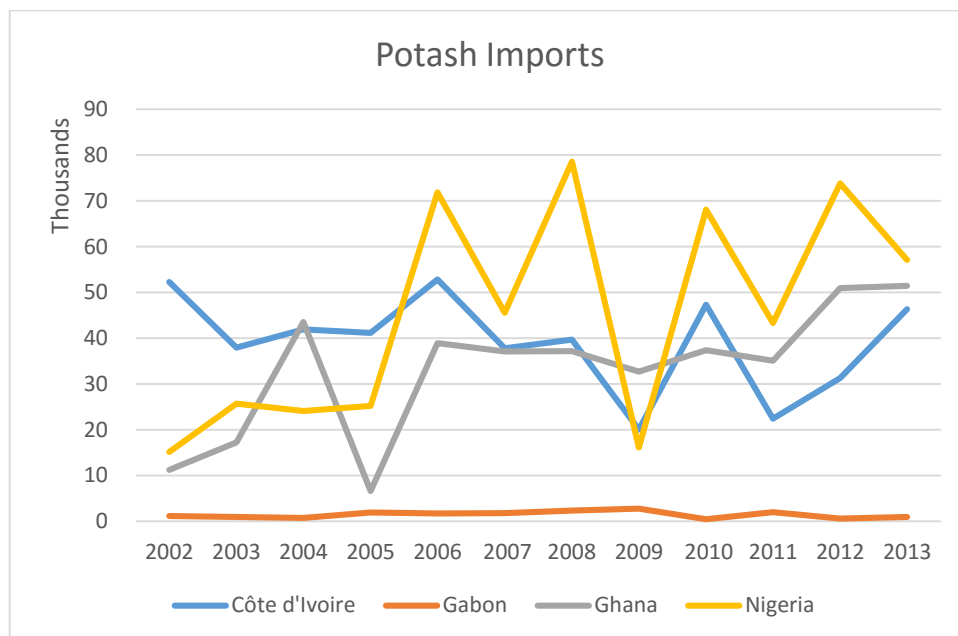


Figure 18. Potash Imports in Ghana and some selected countries, in nutrients of tonnes, 2002-2013.

Source: Authors Analysis data from FAO (2016)

#### 4.2.2.1 Water Usage in Agriculture

Darkwah (2013), states that lack of water is a larger problem in Africa than anywhere in the world, which Ghana is not an exception. The irrigation Capacity of Ghana is gradually improving despite the fact that, it is barely utilized due to its expensive nature for farmers. The area equipped for irrigation in Ghana (1000 per Ha) in 1993 to 1997 was 3.88, this however increased to 30.27 (1000 per Ha) within 2008 to 2012 as per data assessed from FAO (2016).

Also, total harvested irrigated crop area was 60.5 (1000 per Ha) within 2008 to 2012. From the period 1998/2002 to 2008/12, there was 47% improvement in the land area equipped for actual irrigation. This shows that there is some level of improvement with the provision of water for cropping. As such the over-reliance on weather conditions favorable for plant growth is been curtailed.

#### 4.2.2.2 The Labor Force in Agriculture in Ghana

The labor force in agriculture with respect to the total population over almost 15 years period shows that even though agriculture plays a central role in the country as a dominating work force, it is gradually declining. However, this is not to say that labor force in totality is gaining an upper hand. Both are receding. The country labor receding can be as a result of a number of factors such as, electricity power outages over the recent half decade, corruption index which is on the increase, and the current heat wave across the Sub-Saharan African region which is dimension production.

Table 6. Evolution of Population and labour force size in Ghana

	Size (millions)				Annual Growth Rate %		
	2000	2005	2010	2015	2000-2005	2005-2010	2010-2015
<b>Total population</b>	18.82	21.38	24.26	26.98	2.58	2.56	2.15
<b>Total labor force</b>	8.23	9.47	11.08	12.78	2.85	3.19	2.15
<b>Labor force in Agriculture</b>	4.70	5.27	6.03	6.79	2.32	2.74	2.4

Source: FAO, (2016)

Table 6 indicates that current labor force of agriculture labor is 6.79 million FAO(2015), this number has reduced nearly by seven hundred and ninety thousand from the year 2010. The growth rate was down by 2.4%. It can be seen that total labor force in 2010 increased from a little above eleven million to 12.7 million in 2015 , thus 2.15% growth rate change ( table 6).

### 4.3 Food Security in Ghana

From the tables below with data extracted from Economics Intelligence Unit, there is a good indication that a little over 50% of the populace were sound with an availability of food, thus with Ghana and Cote d'Ivoire. This situation was better off than Cameroon and Nigeria (both with about 45%) in 2015. Even though these figures are not encouraging, there are strides to

attaining the objects of food security, with a key aim of poverty alleviation, reduction in malnutrition and nutrient deficient diseases as a whole.



Figure 19. Three Pillars of food security in Ghana and some selected countries in West Africa, 2015

Source: Author's analysis (data assessed from Economics Intelligence Unit (2016))

Revisiting figure 19, the index presented by economics intelligence unit , it was made known that some weaknesses envisaged was with regards to public expenditure on agriculture Research and Development, which was at 12.5 and the gross domestic product per capita (PPP) at 3.5.8

<sup>8</sup> . Marginal increases was attained in micronutrient availability which was at 51.5, sufficiency of supply at 60.2, political stability risk 61.1, urban absorption capacity at 63.4 and nutritional standards around 65.

### 4.3.1 Food Availability in Ghana

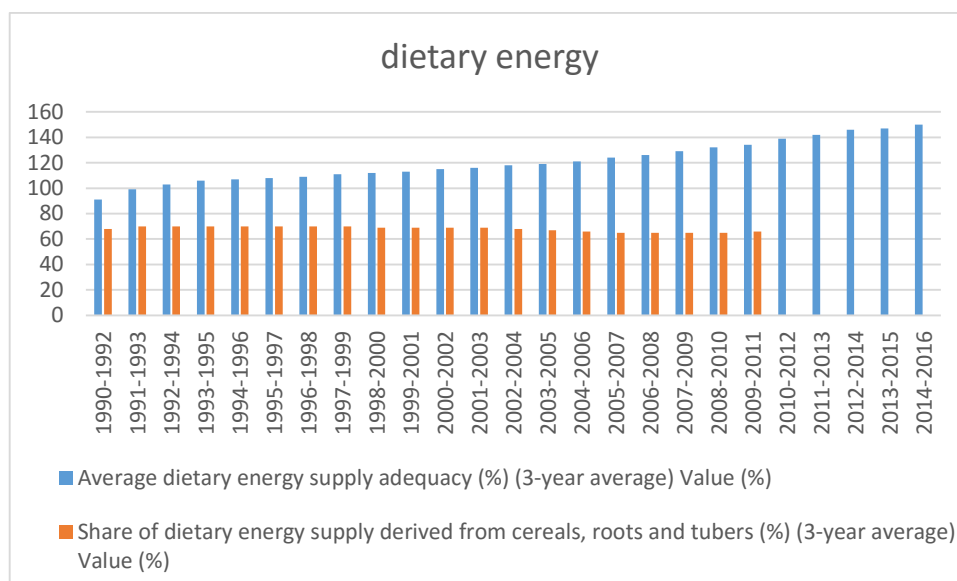


Figure 20. Dietary energy in Ghana, 1990-1992 to 2014-2016

Source: Author's analysis, data from FAO (2016).

The dietary energy supply was quite remarkable as depicted by figure 20. There was an increase through out the period from 1990 to 2014 with regards to adequacy energy supply averages. That of the share of dietary energy supply derived from cereals, roots and tubers dipped down from 2002 to 2011.

In total performance with regards to the food security index, Indonesia, Ghana and Cote d'Ivoire all had roughly 46% (availability, affordability, quality, and safety, taking note that economics intelligence unit uses these 3 variables in accessing effectiveness and performance towards moving to a food secure zone). These three countries amongst (all belonging to the moderate environment category) others such as Dominican Republic, Kazakhstan, Azerbaijan, Paraguay, Morocco etc. From the regional dynamics of food security performances FAO, (2015), Azerbaijan and Kazakstan had serious problems in their regions which needed attention. The issue now is that, if these 2 countries had impeding problems to solve, of which Ghana is performing lower than them, then there is indeed a situation of high poverty surrounding the sub-Saharan African region. Ghana must strive to move from the moderate environment to good environment category.

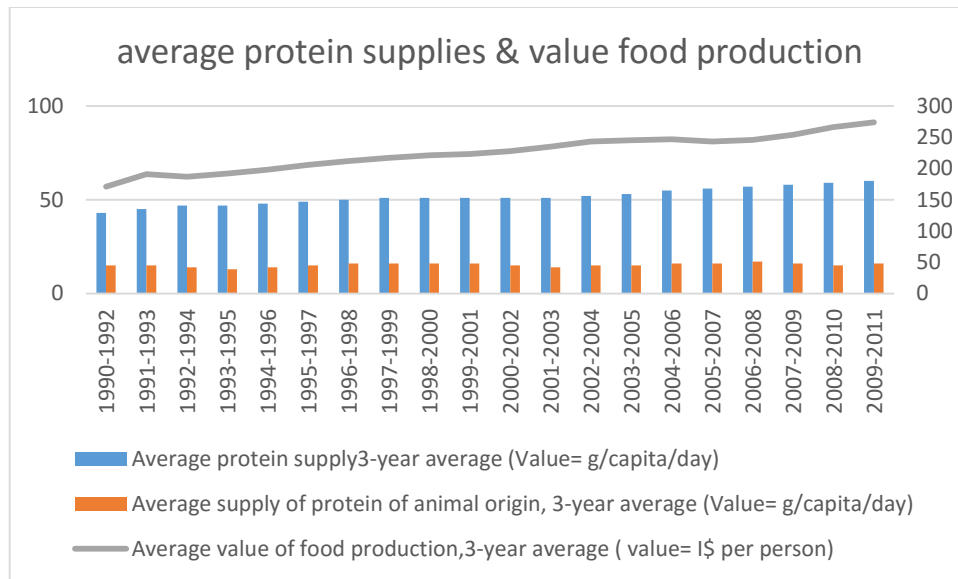


Figure 21. Average protein supplies and value of food production in Ghana, value=g/capital/day, 1990-1992 to 2009-2011

Source: Author's analysis, data from FAO (2016).

Greece was position 73 on the overall score whiles Ghana placed 46. There is a difference of roughly 27 points (this point is the overall score for Chad, the last but one country in performance with regards to food security under the need improvement category). This indicates that there is a lot of work to be done for Ghana to move from being a moderate performing food secure country. Hungary, Suadi Arabia, and Slovakia had total scores as follows; 71,72 and 70. To be part of good environment performing economies, one must be performing between 58 points to 74 points, Economics intelligence Unit (2015).

#### 4.3.2 Food Affordability in Ghana

**Affordability** Affordability is a variant of accessibility with regards to the food security pillars. Most countries in West Africa did not perform as should be regarded to developed countries. Ghana's condition was better than that of Nigeria and Cameroon. Cote D'ivore seems to have fared well with this, attaining a little above 40%. All 3 countries were under 50% share of affordability; this indicates that more than half the population of people find difficulty with having food. Ghana seeks to be part of the good environment performing countries. With regards to affordability, quality and safety Ghana scored around 34 and 47 points, Greece and Slovakia as per affordability scored roughly 76 points, whiles Hungary and Saudi Arabia scored higher (nearly 78 points and 80points respectively) as per affordability. All three countries in the good environment category above discussed had between 64 and 67 points

with regards to availability, there was some level of affordability with Ghana attaining 56 points, economist intelligence unit (2015).

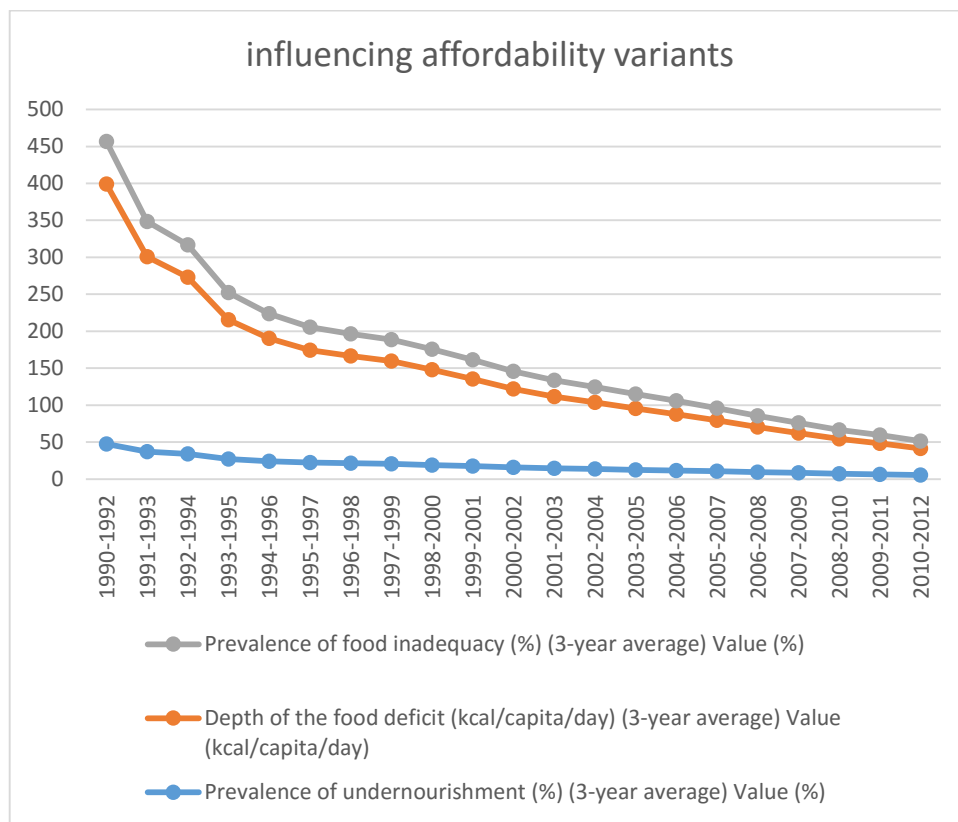


Figure 22. Influencing variants of affordability in Ghana, in percentage, 1990-1992 to 2010-2012

Source: Author's analysis from FAO, (2016).

An in-depth analysis of food availability can be seen from the depth of food deficit within the country (Figure 22). From 1992 to 2012 there is an improvement 352 to 36 (Kcal/capital/day). This is quite remarkable with the 10 year period. From 1992, there was roughly 47% improvement on the prevalence of undernourishment. From the above there is a considerable amount of work being done by successive governments to improving the affordability of food from agriculture production to solving food insecurity in the country.



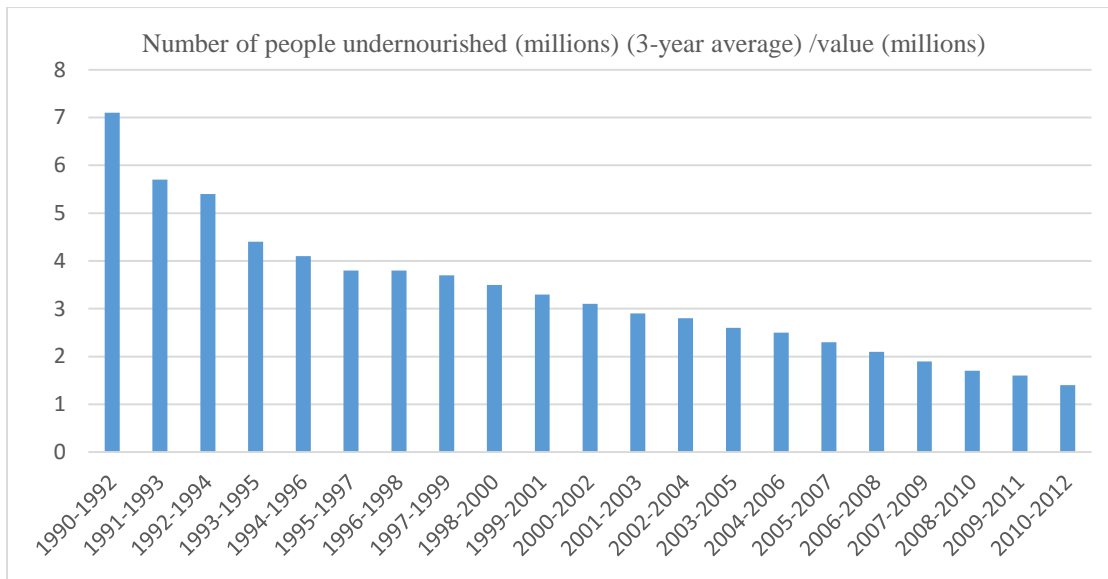


Figure 23. Undernourishment of people in Ghana, millions, 1990-1992 to 2010-2012

Source: Author's analysis, data from FAO (2016)

It can be seen (figure 23) that there is good work being carried out on the number of undernourished people in Ghana. Figure 24 depicts that, during the period 1990-1992 there was a little over 7.1 million malnourished and stunted growth in the country. This has been reduced to nearly 1.4 million people as at the period 2010 to 2012. Maxwell (2000) states that the nutritional status of children need to be improved upon given good health care. He states that the people in the capital, Accra rely heavily on the urban market for food access ( 90% of food consumed is purchased by cash, 6 % come from gifts). Also is the issue that 7% (in value terms) of HH engaged in urban agriculture prepare home made food. The high amount of income were spent on the street or prepared foods taking a larger portion of the income of people living in urban areas. Inter-household transfer of money was a key factor to livelihood due to the culture setting of most Ghanaians (this is noted with low-income HH receiving unconditional support from friends and families)

#### 4.3.3 Food Utilization in Ghana

The utilization aspect of food security was not far different in the case of Nigeria with both attaining between 47 % and 48%. This was manifested with the quality and safety of food. Cameroon stood at above 50%, and this depicts better grounds for the populace.

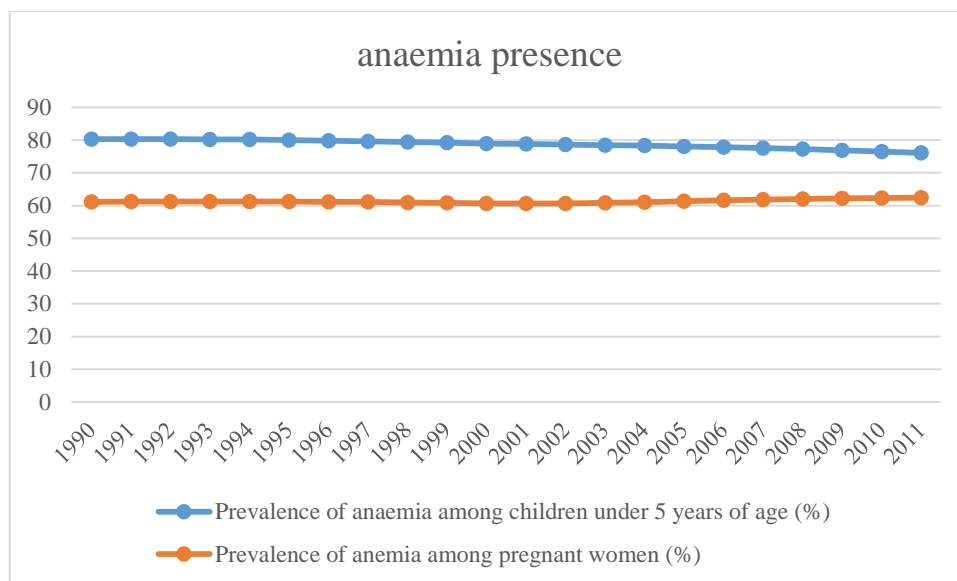


Figure 24. Percentage of Anaemia presence in children and pregnant women in Ghana, 1990 to 2011

Source: Author's Analysis's analysis, data from FAO(2016).

From figure 24, it can be noticed that anemia is still a problem within the country. The trend has not changed much over time and during the 10 year period, this increased with that of pregnant women from 61.1 in 1990 to 62.4 in 2014. However the condition related to children under 5 years was better (there was a decrease of 4.2 % from 1990 to 2011).

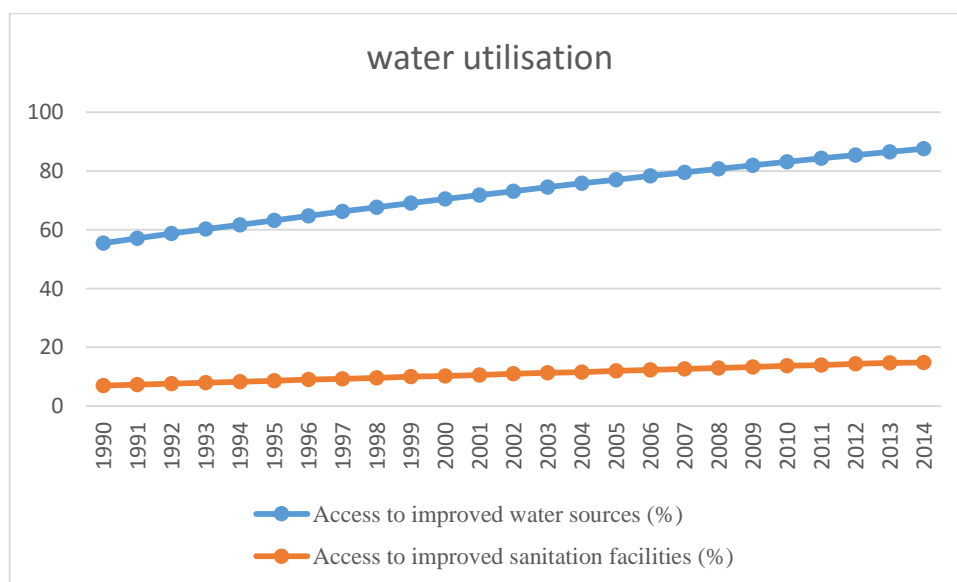


Figure 25. Percentage water utilisation in Ghana, 1990 to 2014.

Source: Author's analysis, data from FAO (2015).

Figure 25 shows the improvement of access to improved water sources which is of key importance to food nutrition. Water consumption for crop production is also key to agriculture

production, so is its access for sanitation purposes. The trend line did not change much over time with the improved water sanitation facilities (7% to 14.8% , from 1990 to 2014) as in comparison with improved water sources (55% to 86% from 1990 to 2014).

#### 4.3.4 Food Stability and Safety in Ghana

Food security indexes will be viewed through the use of the following indicators; the prevalence of undernourishment, average dietary supply adequacy, domestic food price index, the percentage of children under five years who are underweight. According to Maxwell (2000), life in urban areas pose a challenge to working mothers. This is due to the fact that, they must work and balance childcare, this, however, presents an acute challenging situation. The effect is not out of hand due to the fact that, most often women take their kids along to their workplace.

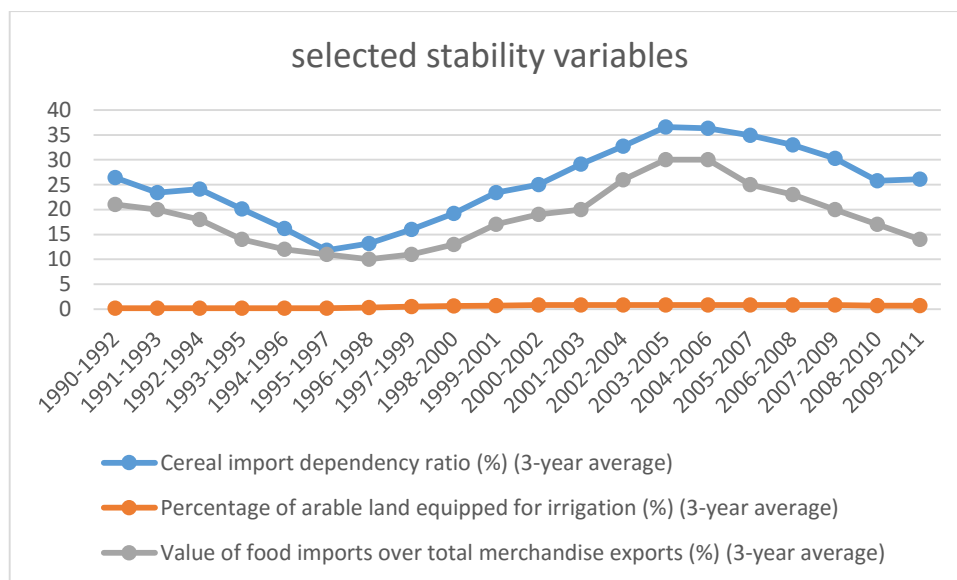


Figure 26. Some selected stability variables in Ghana, 1990-1992 to 2009-2011

Source: Author's analysis, data from FAO (2016)

There seems to be some improvement (figure 26) with cereal import dependency ratio and value of food imported within the period. From 1990 to 1997 which after there was a jump to 2005 and a further steady declined. This was same for the value of imports of total exports, thus, could be a contributing factor to the ailing economy of the country on deficit budgets which as well put pressure in resolving food security problems in the country. It can be seen that irrigation is the little application for agriculture production. To be on 0.2% facilitation of arable farmlands during 1990-1992 and rise marginal to 0.8% and be stagnant from 2002 to

2009 and further drop between 2009-2011 to 7%, this indicates that, there is the need to addressing this situation, since it's not in a good position for aiding agricultural production for solving food security issues (figure 26).

In order for a clear picture of the impact of food security on the country, a comparison is made amongst Slovakia, Greece and Saudi Arabia with Ghana inclusive ( because of the notion that those 3 countries stated are in the category of good environment, for which Ghana aspire to be there in the nearer future).

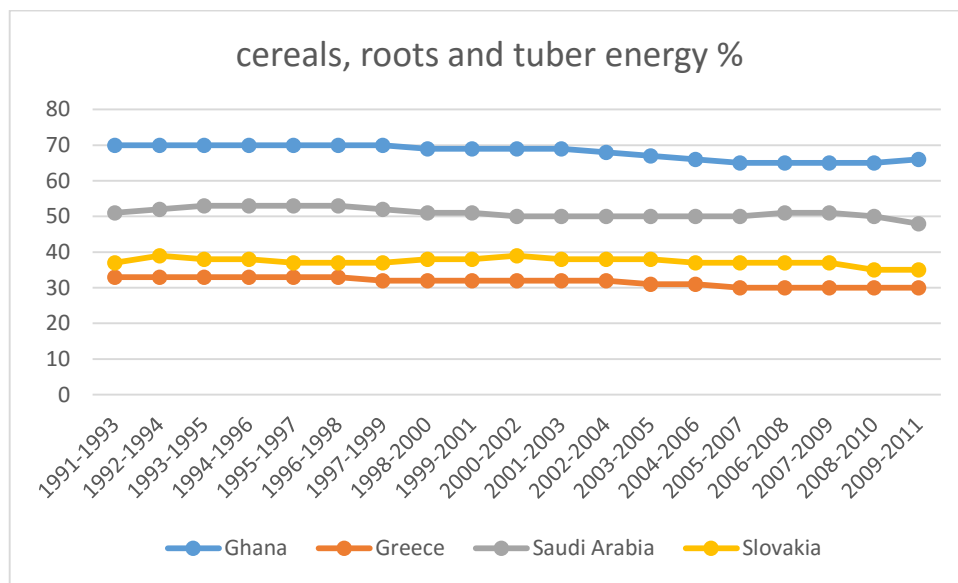


Figure 27. Percentage share of dietary energy in cereals, roots & tubers, Ghana, Greece, Saudi Arabia and Slovakia, 1991-1993 to 2009-2011

Source: Author's analysis, data from FAO (2016)

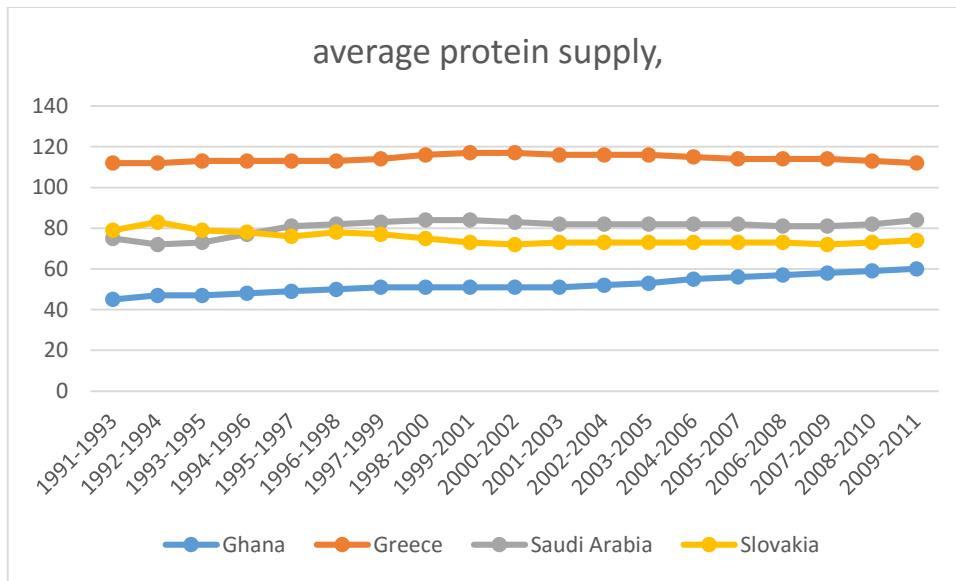


Figure 28. Share of average protein supply, (g/capita/day) (3-year average), selected good environment countries and Ghana, 1991-1993 to 2009-2011

Source: Author's data assessed from FAO (2016)

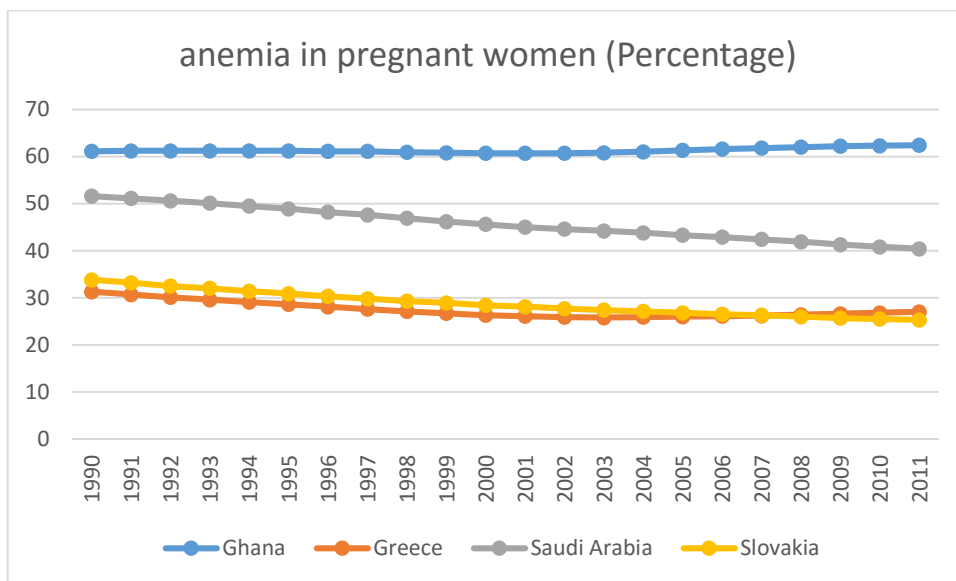


Figure 29. Anemia presence (value in percentage) in pregnant of selected Good environment countries and Ghana, 1990 to 2011

Source: Author's data assessed from FAO (2016)

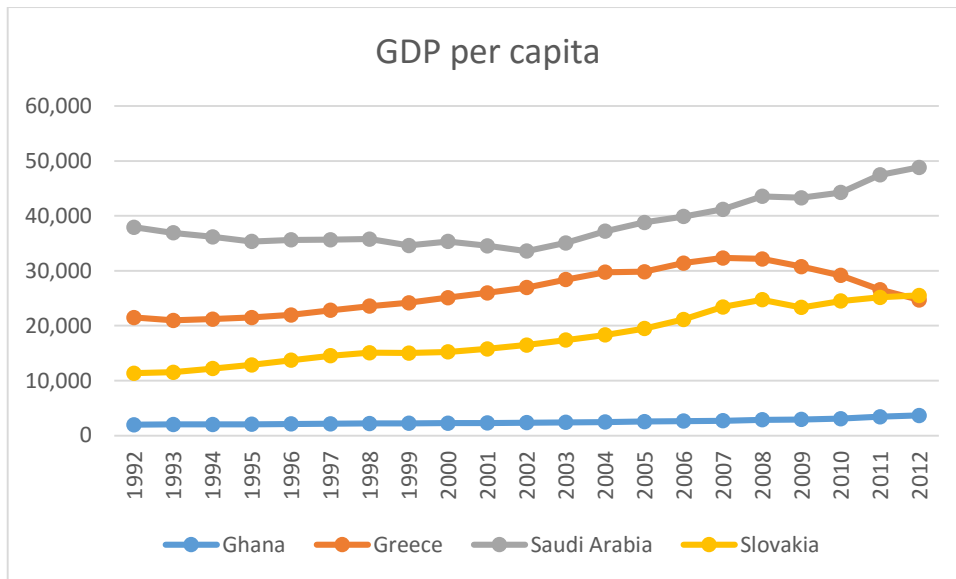


Figure 30. GDP per capita of selected Good environment countries and Ghana , 1992 to 2012 (Gross Production Value (constant 2004-2006 1000 I\$) (1000 Int. \$)

Source: Author's data assessed from FAO (2016)

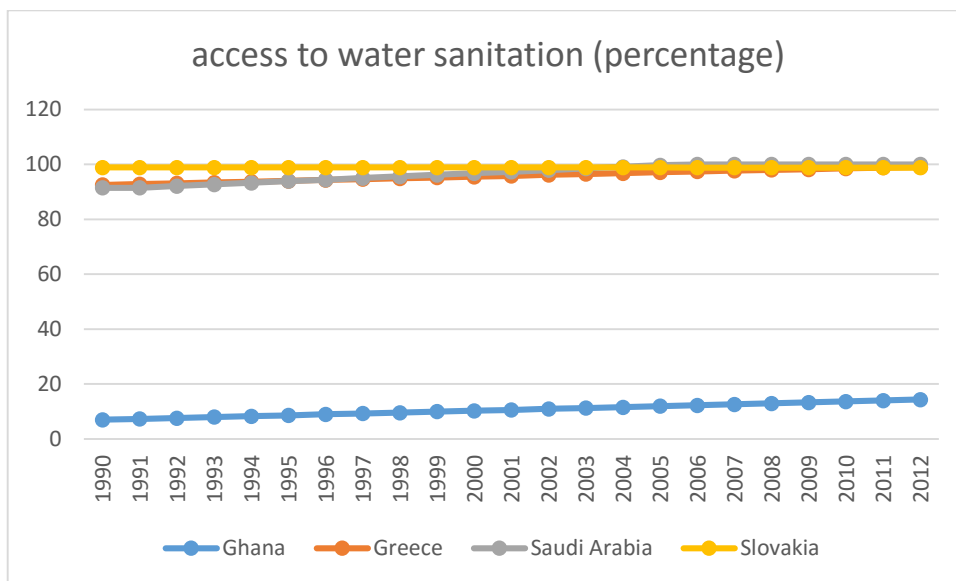


Figure 31. The percentage access to water sanitation , selected Good environment countries and Ghana

Source: Author's data assessed from FAO (2016)

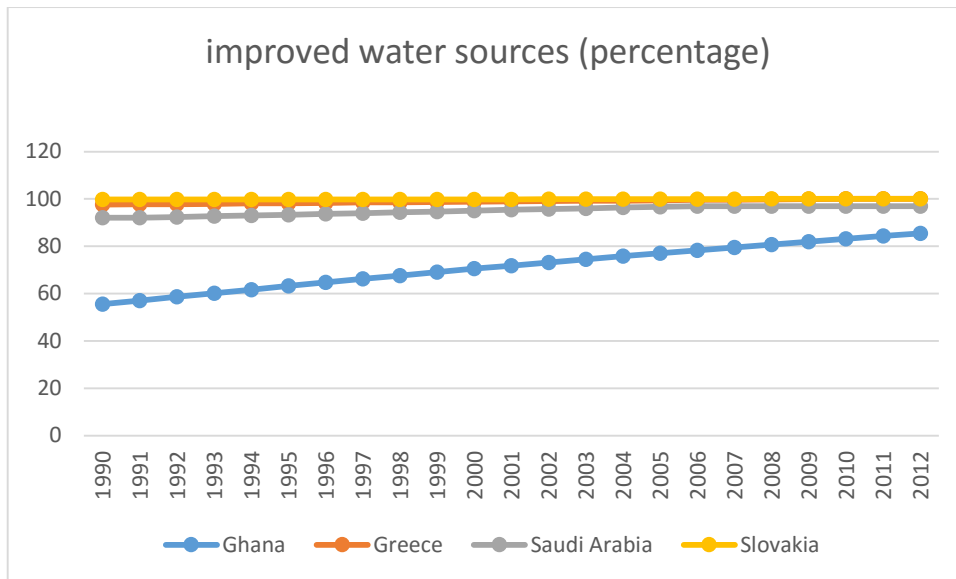


Figure 32. Percentage access to improved water sources, selected Good environment countries and Ghana 1990 to 2012

Source: Author's data assessed from FAO (2016)

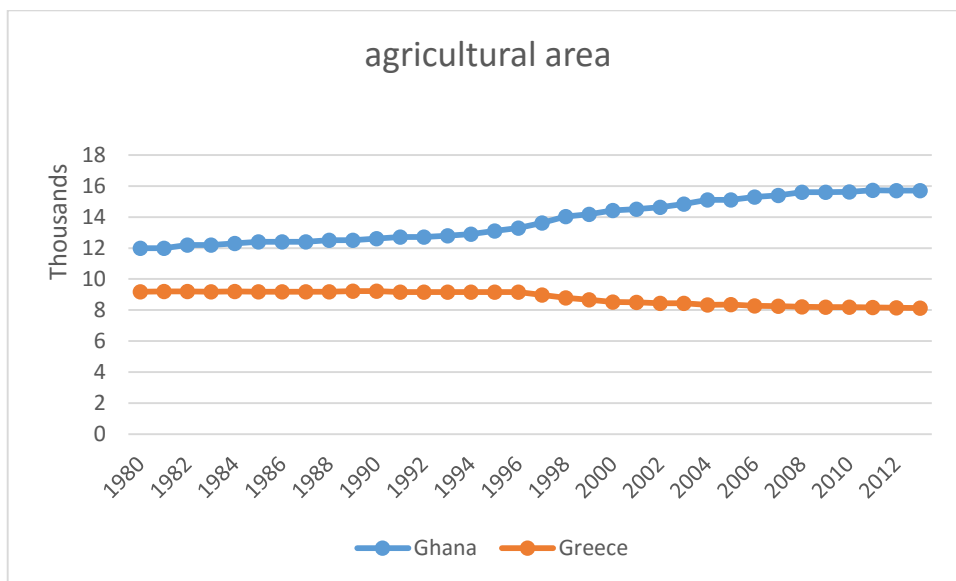


Figure 33. Agricultural area, Ghana and Greece, 1980 to 2012 ( in 1000Ha)

Source: Author's data assessed from FAO (2016)

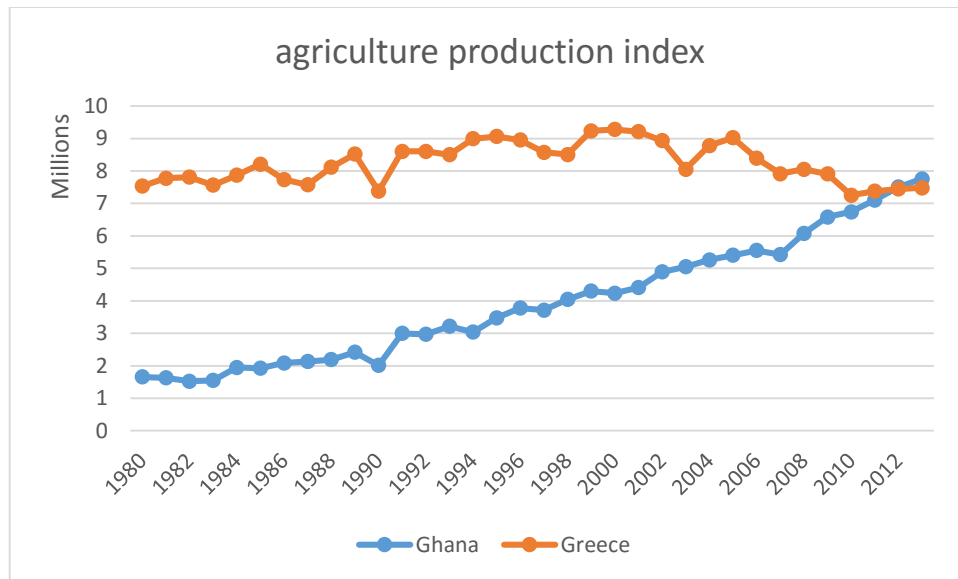


Figure 34. Value of agricultural production, Ghana and Greece Value (2004-2006 1000 I\$) (1000 Int. \$)

Source: Author's data assessed from FAO (2016).

During the period of 1991/1993 to 2009/2011, from figure 27. it is noticed that there is a good share of dietary energy consumption in Ghana as compared to Greece, Saudi Arabia, and Slovakia gained from cereals, roots, and tubers. This may be due to the energy composition of food crops or the dietary compositions of meals in Ghana.

The results in figure 28. shows that protein supply of Ghana is far below expectation for Ghana to move up to being a good environment class of food security. During the entire period, Ghana moved from 45 to 60 (g/capita/day) while Greece had attained 112 points uniformly throughout the same period.

Anaemia prevalence (figure 29) looking at figure 30 indeed is a worrying case for Ghana. Slovakia and Greece had minimal representation than as compared in Ghana. It is surprising to see that, during the period 1990 to 2011, Greece, Slovakia, and Saudi Arabia tried to decrease this problem they had. On the other hand, Ghana's case was different, conditions were rather increasing after the marginal drop in 2000 to 2002.

Despite the value of production, Ghana has with its agricultural production, Figure 30 (GDP), depicts that, it is on the low. Slovakia made remarkable improvement throughout the entire period, while Saudi dropped from 1999 (a little over 37,000) to 2002 (roughly 33,000) till it regained strength and quickly rose up continually till 2012(nearly 49,000).



Looking at Figure 31, carefully, one can identify the disparity of water sanitation access. In fact, the result shows that it is degrading with regards to Ghana's performance (refer to appendix 1 and appendix 3 for geographical maps with relevant allocations to the various villages, towns and cities). However, there is some amount of effort trying to address this situation. Water sanitation problems are 5 times better in Greece, Slovakia, and Saudi Arabia.

Ghana as per figure 32 is making some progress to having improved water sources. Throughout the period from 1990 2012. It can be seen that although Greece, Slovakia, and Saudi Arabia have higher improved water sources which was pretty much stable during the entire period, Ghana is trying to improve the situation.

The agriculture productivity of Ghana is quite impressive, Figure 34, and shows that there were some few drops occurring in 1990 and 2007. Even though it was well below that of Greece, in 1980 the agricultural production index of Ghana and Greece was a roughly 1.6 million for Ghana and 7.5 million for Greece. The productivity of Greece had intermittent drops and rises throughout the entire period (figure 34).

#### **4.4 Prospects and Challenges of Agricultural Production and Food Security in Ghana**

Ghana news agency in April 2016, reports that research done by Centre for Democratic Development ( CDD) shows that graduate has been unemployed over a period of 5 years. They state that 14 % of Ghana's unemployed graduates intend leaving the shores of Ghana for better living and job opportunities. In 2000, the world bank recorded 10% rate of unemployment, this improved to 3.6% in 2006 and rose up to 5.3% in 2010 , which implies that current, structural programs done to improving development in the country are having a negative impact on growth. This negative impact has consequences on the improvement of food security situation in the country. Obeng-Odoom (2013), states that reasonably it is justifiable that Economic recovery programs did worsen the state of affairs of the country.

In 2004, Ghanaweb stated on its page that unemployment with regards to graduates is on a breaking high. This is due to the fact there are some missing links between industry and tertiary institutions to foster job creation ( not partly due to the industries, but the industrial sector is too small to be of resolution to this shortfall). The country policy makers are unable to use the expertise of trained graduates to move the economy out of poverty and indebtedness.

This inhibits on agricultural productivity also due to the fact that, the contribution of agriculture to GDP is on the declined.

Geelhoed et. al in their investigation in Ghana, state that, pregnant women had less than 4 visits to hospitals for anti natal care, and also there were a high number of cases with urinary tract infections of most pregnant women. This could be however attributed to water sanitation problem issues. An investigation revealed in Agogo, Ghana 74% individuals had mild anemia, 20% had moderate anemia, 12.6% had severe anemia. It is interesting to know that the age group 21 to 30 had had the highest number of participants with cases of moderate anemia (30%). The mean age for severe anemia groups stood at 38.83, Kotey (2012).

His work identified the following causes of anemia, though ( issues identified are just stated, thus not core to work objective, but for arriving at solutions to improving food security). malaria, intestinal parasites, blood in stool, folate deficiency, vitamin B12 deficiency, Iron deficiency, low ferritin. From Kotey (2012) investigation, the most prevalent of them were Iron deficiency (nearly 70%), malaria (12.5%), parasitic infections such as hook worms worm infestation which is linked to water availability and sanitation, and folate deficiency.

This poses a difficult challenge to the agricultural labor force. The problems associated with red blood cell formation increases food insecurity due to this result.

Jaween (2013) in his dissertation ( Tamale, Ghana) that, the majority of the participants did not meet the mean percentage of daily allowance for energy, protein, and fiber. Also, 40% had mild anemia, and 7% with moderate anemia, this is attributed to the age, income, profession which is highly linked to its prevalence. The lower the income of a household the more likely there is a rise in the provision of nutrient content food and water sanitation facilities.

Channels of distribution: Amikuzuno, (2001,) in his study states that marketing channels for yam production and other staple crops in high demand in Ghana are informal and distribution of marketing favored retailers more than wholesalers and producers (baseline survey on the status of yam research in Ghana, 2010). Transportation cost was almost a quarter of production of transaction costs. Sarkodie (2007) also states in marketing operations most wholesalers and retailers financed their own operations from personal sources of capital. Kintampo another district in Brong Ahafo revealed that major causes of losses were attacked by pests and diseases, (baseline survey on the status of yam research in Ghana, 2010) thus, mechanical injury during harvesting, packaging, unloading and loading during the transportation of

produce to markets Kyereh, (2008). Badoo (2007) ie. baseline survey on the status of yam research in Ghana, 2010, also indicates that programs from government were geared more towards exporters to the detriment of the farmers who cultivated the yams. In addition from the exporters decreased drastically from 1995 to 2003 to almost half as against foreign exchange earnings from yam export which increased from the same period due to a regulation of the supply of yam exports among others such as agriculture trade fairs.

Other issues affecting production was a decline in fertility of soil which is in relation to factors such as limited credit facilities, low extension services, and inefficient marketing systems (non-existent) by Achirinah et al. (1996).

Food Waste and post-harvest losses; among other issues such as bad weather conditions for the growth of crops, less application of pest and diseases control practices and machinery and bottlenecks in government policies are the key problems to agriculture production. This has serious effects on the food security consciousness of the country in a whole. These issues can easily be quantified and assessed for effective resolution. This study, therefore, looks at macroeconomic factors such as Real Gross Domestic Product (Real GDP), Inflation, Agricultural labor, foreign direct Investment (FDI) and consumer price index in relation to its agricultural production which plays a part in food security.

There are long term consequences of food insecurity at both macro (inflation and real GDP) and micro levels as well as socioeconomic (good transportation systems i.e. paved roads, effective storage systems, weather and rainfall pattern, food processing plants etc.) levels. Poverty is the result of this which raises issues on sicknesses, diseases infestation, malnutrition this affects economic development and growth due to the direct relationship between manual or traditional hands on labor driven by most African economies which Ghana is part of. Poverty is a result of direct losses on job performance, loss of quality education and resources economic to the health industry. In most cases household food security is dependent on substance farming practices and gender patterns. Education does not play a pivotal role. Customs and traditions are also issues which inhibit the promotion of increasing agricultural productivity due to the fact that, women mostly play the dominant role in marketing stage of agriculture production. Permaturess.com (Ghana permaculture institute), reports that the northern part of the Ghana is slowing being less green cover due to the activities of a tree falling, increasing demand for fire wood for cooking, bush fires and the traditional mode of large-scale drying out of land for agricultural practices i.e. over-ploughing and monoculture. The people at the

north have the issue of overgrazing of livestock with unpredictable rainfall patterns causing crop planting failure. These serves as a catalyst to increasing desertification.

From hindsight, the main challenges to agriculture production and food security are; input; farm inputs such as tools, equipment's, fertilizer application and so on, water; irrigation capacity and water accessibility and affordability. Also are Diseases; through pollution of water bodies, air and solid waste disposal and the provision of agricultural extension services problem. In addition, there is diminishing rural agricultural labor; most often farmers are the poor nationwide, this makes agriculture farming unattractive for the rural youth to patronize. Ecological Conditions; weather conditions due to a reliability of rain-fed farming practices, Africaw.com (2016) i.e. major problems facing Ghana's today.

Enu and Obeng (2013) in their work on Ghana, points out the macrofactors that affect agriculture are the labor force, inflation and real exchange rate and GDP. The issue of climate change is key to affecting agriculture and food security by changing patterns of rainfall and availability of water, land tenure system and terrestrial resources.

#### **4.5 Policy Overview on Agricultural Sector and Food Security**

Historical Concept of Food Security and Agriculture according to Nyantakyi-Frimpong (2013), revisits the beginnings of agriculture development during the colonial days of Ghana. Policies during colonial era were mostly linked to the export of cash crops; cocoa being the most emphasized and resulted in a down size on staple food crops for household consumption.

There was the power exertion on exports which led to numerous industrial developments in most parts of the country, of which southern Ghana was dominant in an allocation of such developments.

The poll tax was introduced making farming decline with respect to involvement from people (one shelling payable per person, man or woman or child.). This made people divert their attention from farming to wage labor to pay for this tax and other taxes exerted on them. Policies were influenced by the government then by the desire for independence, leading to the first time 5 year development plan before attainment of Independence.

The African development corporation (ADC) implemented setup through the attainment of independence (1956 onwards) there was a major drift from capitalist development policies vis-à-vis socialist policies. Throughout successive years to date, there has been a mixed or variation

in use. Capitalist policies were abandoned and replaced by socialist policies in 1970, however, socialist policies were inculcated before this period, due to the fact that in 1996 socialist policies were put aside due to coup d'état of the ruling government for capitalism development and growth Albatania et al. (2012), geared towards improving farm production.

The strategy during the 70's and early 80's (before 1983/4 hunger strike) was linked to food security and its modes of distribution. During 1972, the government came up with the Ghana food distribution corporation (GFDC), with its core mandates as; to promote food production through price-marketing strategies in favor of poor households and ensuring the efficiency and effectiveness in food security nationwide (Abatania, Hailu, and Mugeru, 2012).

Grains during bumper seasons were stored and distributed during the periods when food prices went up in Ghana. Prices of food commodities were sold far below prevailing market prices and also did not sell food to consumers at traditional market areas, which was one of the major setbacks (food was sold at vantage located government offices).

There was a , however, problem of the capacity from the government to buy all grains from farmers making the price support program be a challenge. The concentration on middlemen to buy from the GFDC due to the fact that, it was supportive of larger quantity purchases broke-up the system (defeating the purpose for which it was created that is for rural folks and the household beneficiary).

The country was self-sufficient in rice from 1974 and 1975. Agricultural policies in the 70's was supported keenly with attention to rural development in providing incentives in crop production, Abatania, Hailu and Mugeru (2012), improvement of road infrastructures, rural water and electrification so as to enhance the rural folks to develop the likeness to effectively increasing agricultural production with enjoying urban life styles.

The mid period of 1983, Ghana's economy was crumbling, due to severe drought and farming across the West Coast. Food security during this era, was heightened by Thomas Isidore Noel Sankara (nick named the CHE of Africa, look alike in attitude of Ernesto Guevara), who was a Marxist revolutionist and Burkinabe (Burkina Faso is a neighbour country of Ghana, located on the North), heightened the resistance and need to being food resilient and sufficient within the Western part of Africa (author's analysis).

GDP had fallen to 0.4%, there was a national debt over \$ 1 billion (1983). Help was sought from the government through World Bank and IMF through the Structural Adjustment Program (SAP) to strengthen the state of the economy.

There was an effective undertaking with understandings from these parties which assisted Ghana with around \$1.4 billion, (Nyantakyi-Frimpong 2013). The government during the 1990's embarked on programs to reduce policy and amalgamate the gains of the SAP. In 2003-2006 the government put in place the Ghana poverty reduction strategy (GPRS I) to look at solving decline in economy's progress.

This GPRS I was geared toward enhancing macroeconomic stability for a sustainable economic growth and the alleviation of poverty. Cereals post-harvest losses attained its intended target of 15% to 20% in the mid-2000's which brought the GPRS II launched with emphasis to improving productivity in agriculture.

#### **4.6 New Era Policies and Programmes, Projects and Development Partners.**

There are quite some number of international organizations that have an interest in Ghana. This is due to the fact that, Ghana is one of the few countries that is aiming to abide by most frameworks abound by democratic principles i.e Ministry of Food and Agriculture of Ghana (MOFA). Table 7 is a list of development partners in the agriculture sector, boosting the country to be food secure and in improving on agricultural production.

*Table 7 Agricultural development partners in Ghana*

<b>No.</b>	<b>Description</b>
<b>1</b>	African Development Bank,
<b>2</b>	Alliance for Green Revolution for Africa,
<b>3</b>	Agra Programs and Grants In Ghana,
<b>4</b>	Engineers without Borders International
<b>5</b>	Food and Agriculture Organisation (FAO),
<b>6</b>	German Development Cooperation In Agriculture,
<b>7</b>	International Food Policy Research Institute,
<b>8</b>	International Fund for Agricultural Development (IFAD),
<b>9</b>	International Water Management Institute,
<b>10</b>	Japan International Cooperation Agency (JICA),
<b>11</b>	Millennium Challenge Corporation,
<b>12</b>	United States Agency for International Development (USAID)
<b>13</b>	World Bank and World Food Programme,

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*Source : Author's analysis (2016)*

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The northern rural growth program is under the auspices of Ministry of food and agriculture and is a program with the aim to providing a sustainable poverty reduction and food security in rural households with specifics to northern Ghana. This program is implemented in 32 districts over a 6 year period with the start date from 2009 (however is an on-going) and based on four key areas. These areas are commodity chain development, rural infrastructure, access to financial services and program coordination (MOFA, 2016).

1. United States Agency for International Development (USAID): The United States have long had external relations with Ghana amongst other African countries ie. Nigeria, Cote d'ivoire, Egypt, Gabon, Cameroon etc. for reasons of common interest. During a 4 year period (2011-2014, USAID) aligned itself to the Ghana government to support the medium term agricultural strategic Implementation Plan (METASIP) and the comprehensive Africa agriculture development program (CAADP). Their main aim was to commercialize staple crop systems and augment management of coastal resources, example the fisheries communities and also was the additional financing provided to financing rural infrastructures. Currently, there are four projects under the assistance of USAID they are as follow:

- a. Agricultural development value chain enhancement program (ADVANCE) i.e \$ 32 million programs for the years 2009 to 2013 to improving competitiveness.
- b. Ghana strategic support programm (GSSP) which is a \$17 million program to look into agricultural research and policy platforms to bring in new trends with an interest in staple crops.
- c. Integrated Coastal and fisheries governance, a \$10 million program for sustainable coastal management and marine ecosystems to improving the living standards of fishing community folks through 2013.
- e. Peace Corps, this supports the production of maize, rice and soybean production (marketing skills as well as other skills such as business and aiding women participation).
- f. Business sector advocacy challenge (BUSAC), this is a joint program done with the Danish government of worth \$ 44 million to improving the business environment in Ghana, through 2014.

g. Monitoring, evaluation, and technical support services (METSS), this program started in 2010 and ended in 2013. This serves as an oversight committee to programs. There are some future support's as envisaged and they include areas such as low-cost venture capital, public private partnerships, agriculture technology transfers, marine and fisheries governance etc (MOFA, 2016).

*Table 8. The World Bank, initiatives for Ghana*

Abbreviation	Description
AgDPO	Budget support for policy reforms
WAAPP	Regional cooperation in agriculture technology generation,
WARPP	Increasing coastal /marine wealth,
LAPP 2	Improving land tenure system and security,
PSNO	Securing household assets.
AgDPO	Budget support for policy reforms,
WAAPP	Regional cooperation in agriculture technology generation,
WARPP	Increasing coastal /marine wealth,
LAPP 2	Improving land tenure system and security,
PSNO	Securing household assets

*Source: Own work*

The country assistance strategy (CAS) was implemented through the guidance of WB which supported the agriculture sector from 2008 to 2011. The objectives of CAS are to sustain economic growth at 6% or more, aid in halving poverty during the CAS period and reduce inequalities. Poverty is key to bring down issues of food insecurity (MOFA, 2016).

3. The Agriculture development policy operation (AgDPO) provides budgetary support for selected policy reforms and currently it is the third (AgDPO) program which was approved in 2011 with a total cost of \$50 million. This budgetary support aid is channeled through issues of finding root causes of diseases affecting crop production, food nutrition studies etc (MOFA 2016).

4. The West Africa agricultural productivity project (WAAPP) enhances regional cooperation in agricultural technology application and also focuses on roots and tuber crops such as yams and cassava with Mali and Senegal as other countries of interest. The LAP2 is of improving land tenure security and easing the process of accessing land and aiding land management for sustainable growth. Root tubers have high production rate due to climate conditions which are suitable for growth. This is the reason why there is a regional consensus to enhancing production, through out the West of Africa (Ghana and Nigeria being the 2 dominant producers in yam, Figure 22 shows that in 2014 both produced closed to 45 million tonnes, MOFA 2016).



5. The WARFP is a 12 country program which seeks to heighten the general wealth derived from marine fisheries.

6. Lastly is Productive safety nets operation directed to northern Ghana for vulnerability and household assets to protect.

The world food programme consists of five objectives, it is to save lives and protect livelihoods in emergencies, prepare for emergencies, restore and rebuild lives after emergencies, reduce chronic hunger and under nutrition and strength the capacity of reducing hunger in countries.

a. Japan International Cooperation Agency (JICA)

The Japanese government provides bilateral aid in the form of technical assistance, loans, and grant aid. May 19th 2016, grant aid of 22,285 million yen was signed for the Ghana government for research into infectious diseases which is to be carried out at Noguchi Memorial Institute for medical research (common infectious diseases are malaria and bronchitis).

b. Canadian International Development Agency (CIDA)

The main aims of CIDA are under two themes, increasing food security and securing the future of children and youth. The Ministry of food and agriculture work hand in hand with CIDA to strengthen, and focus on improving food security in the country.

Table 11: Agricultural Programmes aimed towards improving agricultural production in Ghana. Table 9, presents a list of some of the agricultural programs being carried out by the Ministry of Agriculture, which aids in agricultural production and food security.

*Table 9 . Table of agricultural programmes in Ghana*

<b>No.</b>	<b>Program</b>
<b>1</b>	Support to the food and agriculture sector development policy (SFASDEP),
<b>2</b>	Food security and environment facility,
<b>3</b>	Food security advisory services,
<b>4</b>	Tackling malnutrition in northern Ghana,
<b>5</b>	Assistance to Ghanaian food insecure households,
<b>6</b>	Farmer based organisations (FBO) development fund,
<b>7</b>	Ghana environment management project (GEMP).

*Source: Own work (2016)*

## EMBRAPA

Since 1973 (Brazilian partner) EMBRAPA has assisted in technology assistance in various economies. The support employees, researchers (master's degrees at 25% and doctoral degrees at 75%). They coordinate national agricultural research system in public private partnerships. EMBRAPA has been of keen support in the sugarcane industry of Ghana.

Current and outgoing projects in support of agriculture production.

*Table 12: Projects in place aiding agriculture production and food security for Ghana*

<i>No.</i>	<i>Description</i>
<i>1</i>	<i>Afram plains district agric development project,</i>
<i>2</i>	<i>Export marketing and quality awareness,</i>
<i>3</i>	<i>Inland valley rice development project,</i>
<i>4</i>	<i>Rice sector project,</i>
<i>5</i>	<i>Nerica rice dissemination project (NDRP),</i>
<i>6</i>	<i>Sustainable Development of Rain-fed lowland rice production project,</i>
<i>7</i>	<i>Ghana Commercial Agriculture Project (GCAP)</i>

*Source: Own work (2016)*

The Afram plains district agricultural development project is a 6-year project which ended in 2012 with a 100% execution. There were four components which aided agricultural production and food security in Ghana. They are production development, infrastructure development, project management and infrastructure development. These components were used to aiding crop production, rainwater management with assistance to the cultivation of staple foods for example maize, yam and cashew just to mention a few. The entire project cost was \$32.5 million (MOFA, 2016).

Another project which took place with the objective to boosting agricultural production is the information on export marketing and quality awareness project (EMQAP). This is an agreement between the African Development Bank and Ghana with an equivalent of \$28.84 million in loans. The project commenced in 2007 and ended in 2011. The project's objective

(was production and productivity enhancement) the incomes of farmers in the horticultural sector and cassava producers, thus to add more resilience to boost production (MOFA, 2016).

#### **4.6.1 Programs**

Some of the programs in lieu to agricultural production and food security are listed below. These programs are network programs within some selected West African countries.

1. Root and tuber improvement and marketing program (RTIMP),
2. Northern rural growth program (NRGP),
3. West Africa agricultural productivity program,
4. Programme for the promotion of perennial crops in Ghana.

These listed programs above are controlled by the Ministry of food and Agriculture which aid to improving agricultural production and reducing the poverty gap in Ghana. Throughout the years, it is seen that there is an increase in root tubers. This has contributed to making Ghana one of the leading yam producers in West Africa, the second after Nigeria which is the largest producing country in the world (MOFA, 2016).

FAO (2015), points out the objectives of government of Ghana with regards to food security and nutrition as the national economic plan referred to as the “Vision 2020’ which gives an indication that Ghana could be the first African country to become developed between 2030 and 2039 through the application and fusion of science and technology. There is the Ghana shared growth and development agenda, GSGDA (2010-2013), was purposefully for oil and gas exploration and development, energy enhancement and agricultural modernization for effective improvement in agricultural production. In order to achieve a comprehensive Africa agriculture development program (CAADP) target of 6%, Action Aid (2013) points out that Ghana must have a spending of 14% on total national budget.

The overall budget deficit in the year 2000 remained substantial at 7.9% GDP, (OECD, and AFDB 2002). The fiscal macroeconomic policy of the government of Ghana (GOG) had the objective of reducing the budget deficit in the year 2016 by 5% however this is an illusion. This is due to the fact that there was a substantive expenditure overrun in 2012, Okudzeto et al., (2014), which gave a result to a budget deficit of nearly 6% of GDP.

This widened in 2013 by an additional 1.8% to the previous year. Action aid in it walking the talk report in 2013, analysed that from 2007 to 2011 9% to 10% national budget of government

was allocated to agriculture. Ghana's Medium Term Agriculture Sector Investment Plan (METASIP) made provision to a 10% spending on the national budget until 2015, however, it was adjudged that spending was around 8.5. It is overwhelming surprising to note that in 2011, donor funds for the entire budget through donor funds for agriculture spending was 53%.

The medium term expenditure framework (MTEF) for 2016 to 2018 of Ghana has the following in place for addressing food security. Their aim is to reduce food insecurity through the application of current machines and technology. This is to address issues into irrigation and water management. Till date, the arrangement for storage and distribution is emphasized on improving nutrition and food fortification and most importantly reduce post-harvest losses (thus, the country lacks agro-processing machinery which can aid in securing food for a longer time period ), with the application of diversification into soap making, bead making and so on.

Support to small scale enterprises (SME's) is also looked at with these diversification needs. Developing Early warning systems and emergency preparedness to identify disaster prone zones of the country for mapping in order to resolve an emergency crisis.

#### 4.7 The Role of Agriculture in Ghana's Economy

Gradually from within the 6-year gap, Agricultural sector's role in relation to GDP decreased (figure 35). The decrease was quite enormous (13% overall decrease) due to the fact that in comparison to the service sector, it increased by 5 percent. The industrial sector was almost non-agricultural based, most were related to the mining sector and some light industries including the new oil discovery in the western part of the country. There was a stable trend within the first two years and an increase of 9 percent in 2012 (this year had a percentage of 28 which was stable in the year 2013). The last two years was marked by a decrease by one percent, the sector as at last year is 27% the composition of GDP. Figure 19: Percentage growth share of GDP by sector.

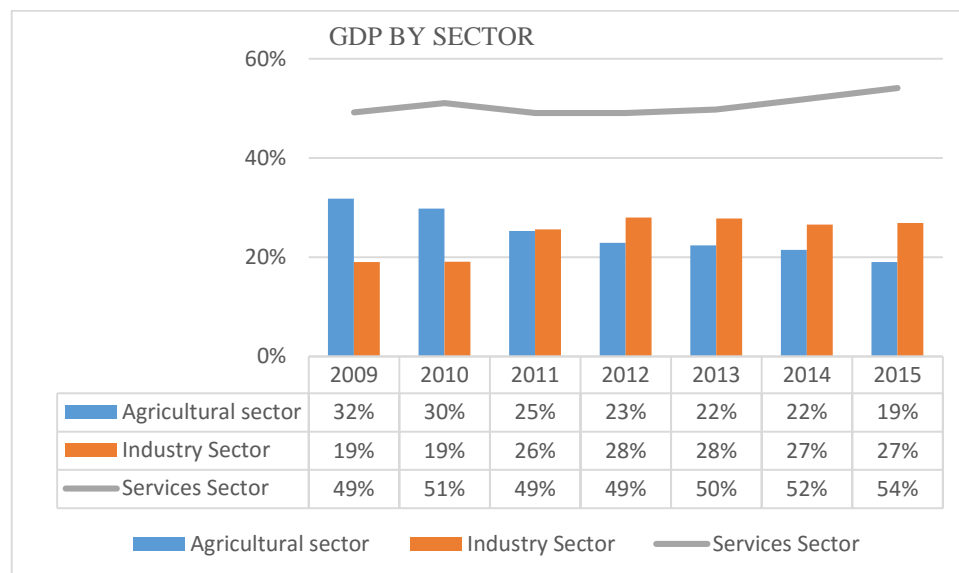


Figure 35. Contribution towards GDP Ghana, 2009-2015

Source: Author's data assessed from Ministry of Finance and Economic Planning of Ghana (2016)

#### 4.8 Data Description

From figure 36, Foreign direct investment (FDI) and inflation have a random path, there is no path or pattern to it and no reason why the trend goes down.

With FDI, there is a peak higher in 2011 with a trough in 2010 which again peaks at 2009 a bit lower than in 2011. This pattern decreases sharply from 2009 to 2005 and which there not much variation going on from that year with minimal rises and stability inclining that this is a negative random trend (minimal variation of FDI trend over time from 2005 down to 1980). Inflation even though random in turn tends to be a bit cyclical which moves downwards depicting a

slightly positive decreasing trend (a decreasing linear trend from 1985 to 2013 with decreasing variability). There starting from the fifth time series graph (Agriculture Labor force) this is a depiction of a seasonality trend consisting of repeating peaks and troughs. This is a positive secular trend with seasonality due to the reasons, that; a decrease in agriculture labor force oddly from years 1981 to 1995 as the trend goes on including 2013 (figure 36).

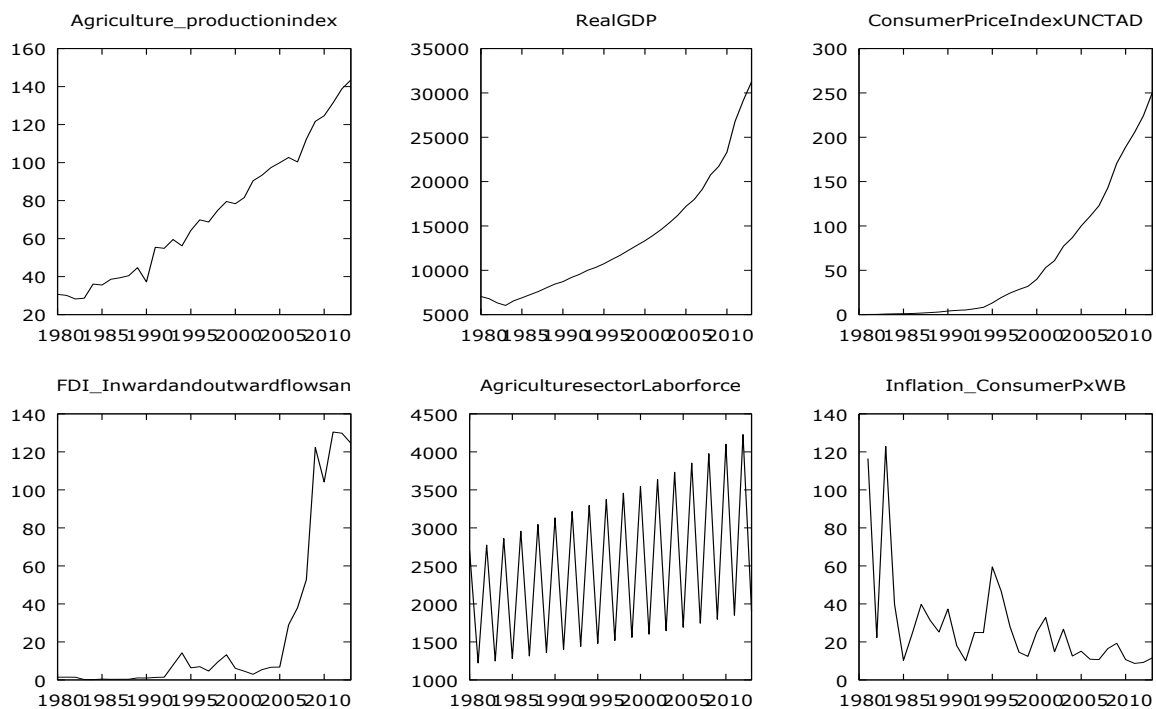


Figure 36. Analysis of some socioeconomic indicators with reference to food security in Ghana

Source: Author's analysis (2016)

There was higher labor force in years evenly (even numbers ) from 1998 to 2012. The second and third graph, Real GDP and Consumer Price index have a secular negative trend (these two are power trend lines in nature). There is an increase in variability of power trend lines with increasing variability over time.

On the other hand, Agricultural production index has a negative cyclical trend which is a bit unpredictable with respect to time gap (years of occurrence) due to the behaviour of the arc. Thus, the labor force shows an increasing linear trend with increasing variability over time

Ordinarily, Agricultural production index = (RGD, CPI, FDI, ASLF, INF+K). Where K is a constant CPI is the consumer price index, INF represents inflation, ALSF represents the agricultural labor sector force and FDI is the foreign direct investment.

There is multiple regression equation model which can be used to explore the macroeconomic factors which have a pull on agriculture production in Ghana is stated below;

$$\ln(\text{API}) = \beta_0 + \beta_1 \ln(\text{RGDP}) + \beta_2 \ln(\text{FDI}) + \beta_3 \ln(\text{ASLF}) + \beta_4 \ln(\text{CPI}) + \beta_5 \ln(\text{Inf}) + \mu$$

This is however based on economic theory and empirical analysis. This is not a part to the thesis, but draws light into future analysis.

## 5 CONCLUSIONS AND RECOMMENDATIONS

### 5.1 Conclusions

There is a good amount of financial resources and obligations carried out through various projects and programs from developed nations in favour for the growth of agricultural production and food security in Ghana. There is some amount of national revenue being used to facilitating agricultural production. From the above deductions, the level of agricultural production does not really reflect the inputs from Government as well as from developing partners of Ghana. To cast back a decade and half ago, overall budget deficit of Ghana in the year 2000 remained substantial at 7.9% GDP, (OECD, 2002).

For Ghana to spend 14% of national budget on agricultural production to boosting food security conditions, this is possibly not feasible with the budget deficit situation in Ghana shown by Okudzeto et. al., (2014) that budget deficit in 2012 was 6% GDP (as a result of substantive budget overrun).

The results also indicate that Ghana is facing a decline in the agricultural labor force as seen from figure 28. Researchers have come out to buttress this issue as this is not a situation being encountered in Ghana, there is a decline in both absolute level and relative importance of agricultural labor (Tocco, Davidova and Bailey 2012). This clearly indicates that the labor decline in the agriculture sector for improving production is somehow related to some dynamics which is orchestrating the drop vis-à-vis the service sector which is on the rise.

From the above explorations carried out, Ghana is making some amount of progress with agricultural production. However, it is evidently seen that cereal import depending ratio is on the increase from Figure 26 (selected stability variables in Ghana). Irrigation is almost nonconformer to agricultural production which is key to food insecurity (figure 31 and figure 32), while water access is not good to talk about. The value of food imports over total merchandise exports is on the increase, this raises issues of the balance of trade in the economy. Improved water sanitation is key to moving up the ladder of food security (as per figure 25). The rate of anaemia deficiency amongst children and pregnant women is eminent and is worrisome (from figure 29).



Undernourishment is still a growing concern with a little over 1.4 million people suffering during the period 2010/2012. There was no data available for food undernourishment with some countries in the good environment category. This either means that, data is scant, which is less likely or there are no such cases in these countries (author's findings from FAO, 2016). Apart from dietary energy supply which Ghana seems to be having a good performance, the share of average protein supply was worse.

Agriculture area and size do not reflect the Real GDP of the country, looking at the GDP of Greece and Ghana vis-à-vis agricultural area for production. This indicates efficiency and effectiveness in agricultural production which is key to providing increased food security. While Greece agriculture land area is decreasing, Ghana's is increasing and is nearly 45% more than the size of Greece (figure 33, figure 34).

Most literature focuses on unemployment burden on the agricultural sector. In an economy where there is underemployment, more informal employment, it is difficult to find empirical solutions to because there due to the fact that statistics on urban employment lack importance, Derek, Bezemer, and Hazell, (2008).

This is to say that, it is not possible to get empirical solutions only that, there may be some bit of misleading results. Also, most leaders and policy makers in less developed countries are concerned primarily with urban revolution than rural dissatisfaction.

## Recommendations

The results of this work implies that, in the short term, these policy recommendations should be put in place in addressing the state of agricultural production and food security.

Government and lawmakers need to identify and balance labor flows within the country. The young population that is less educated are more likely to be involved in the agricultural sector (especially the agricultural production food chain), thus being self-employed due to the fact that, it is not feasible for them to gain employment in the public sector. The educated youth, mostly not married have the mind-set of looking in for industry or service jobs (this mostly due to the fact that they have little knowledge and practice in farming), while farmers have challenges with livestock production and encounter loss in crop production. The more densely populated an area, the more likely it is for people to look out for services and industry jobs. The unemployed youth with less knowledge in agricultural and are most likely to continue

ending up as unemployed. Retirees or pensioners are most likely to remain dormant. There is then a gap to ownership (they have better affiliations with land ownership) of land and the engagement of livestock farming which is less energy consuming than crop production.

Agricultural Production can be improved through the enhancing and extending the provision of external farming education, disease, and pest control among other issues such as having well-balanced meals to curb malnutrition problems. To increase the understanding of agricultural practices and also to provide tools and equipment which will go a further mile to improving the situation of increasing farm size while some developed countries rather are having a shrink in their agricultural area, but having increasing agriculture productivity. Improving the quantity of food supply brings down the problem when there is shortage or price increase in foreign food products. This will result in a direct consumption of farm produces from the farm, which reduces hunger.

Education awareness and assistances, boost food availability, increase, stability and add more income which improves the affordability of accessing the basic necessities in life. Programmes must be regionally based with the key focus on major crops which grow easily and are abundantly produced within regions. , i.e which crops to promote, soil education, water supply systems and how to inculcate sustainable agricultural systems, which will go a long way to the future in resolving the food insecurity challenges of the future generation.

Anaemia is so prevalent in the Ghanaian economy. The food intake and dietary components for pregnant women and children need to be improved through the advancing of public health educations conducted openly for communities. Food fortification should be carried out by food producing industries, and should be monitored and evaluated by sector ministry in charge of health and women and children, with effective implementation of results and findings. There is the need to carry out extensive research to evaluate the micronutrients contents of Ghanaian meals.

In the long-term, the following actions need to be carried out by decision makers to moving Ghana aims to part of the good environment category in food security as well as improving agricultural production. There is the need to the evolving of agrarian politics of this sector is in two forms i.e. producing of specialised goods which in addition satisfies basic human needs. In that, it secures food for the country. Also, this is due to the fact that agricultural production is one of the major driving forces of the economy thus, an oddity can create long lasting

consequences on demand and supply of agricultural and food production goods and services. This is not to translate as some sort of common interest or fractional interests. However, this balances the country with the view to the rational functioning of the economy. We, therefore, propound equally on economical politics and agrarian politics. A system of mission statements and vision of the country created by government (the people, legislative, and executive body). Agricultural production is indirectly connected to nature, therefore, it implies that economic, social, cultural and national interests come into play. The aim of agrarian politics is to secure a sustainable agriculture economy (sustaining of natural, social and economic equilibrium in the landscape). Aesthetic landscape value can be strengthened for leisure purposes, improving the reforestation problems in the country which in the near future can help mitigate propensities of displacement in towns and villages. Increasing agricultural forestry is key to securing better and improved oxygen production which goes a long way in enhancing the quality of life standards is key. There is also the need to regenerate the interest of green cover which improves air filtration and soil fertility problems.

There is also another issue of aiming to for optimal soil utilisation since this goes a long way to boosting agricultural production and improving food security. Soil evaluation should be carried out through research so that indications can be made for soils good for wide range of utilisation capacity. Classifications can be resourceful and useful to making eminent decisions in crop production for the foreseeable future.

There must be a careful balance and use of the following trade policies to solving agriculture production and food insecurity situation in Ghana. The use of liberal or free agricultural trade policies or protectionist trade policies. With liberal trade policies, this is related to no tariff impounding, while protectionist policies seek to protect economic growth and stability with balancing trade. One must, therefore, be versatile with the importance and implications of both. The adaptation to a liberal policy increases promotion of comparative advantages and reduces the unit cost of production and increases consumer's satisfaction due to competition on the domestic market. Adaptation to liberalism aids in solving inflation which is key to monetary policy. Trade liberalisation also maximises wealth. These advantages can be looked at with protectionist policies; there is the transfer effect of imports which has a negative and positive effect looking at the issue of unemployment (unemployment will never end due to preferences of people's demand and level of satisfaction.). The issue is at hand it that increasing production in exports creates more jobs, so is importing products, which creates jobs in distribution

channel of the agricultural production cycle ( in Ghana, this will be only for the short run). This, however, is debatable due to the fact that, some say those affected are the ones who are unable to adapt to changing requirements or can be more innovative. Adaptation to this also curbs the impact of economic openness on macroeconomic stability.

Lastly is the mode of taxation that the country must adapt in order to generate revenue to propel the solidifying of agricultural production to be of interest and to be patronised more by the people of Ghana. Profoundly, “taxation is derived on partial and valid doctrines (example tax equity and low collection costs), the fundamentals of taxation doctrines i.e. ability to pay through the adaptation of marginal equal sacrifice and the benefits principle should be first and foremost taken into consideration. These, when weighed effectively, can determine the right choice of taxation a country can adapt to.

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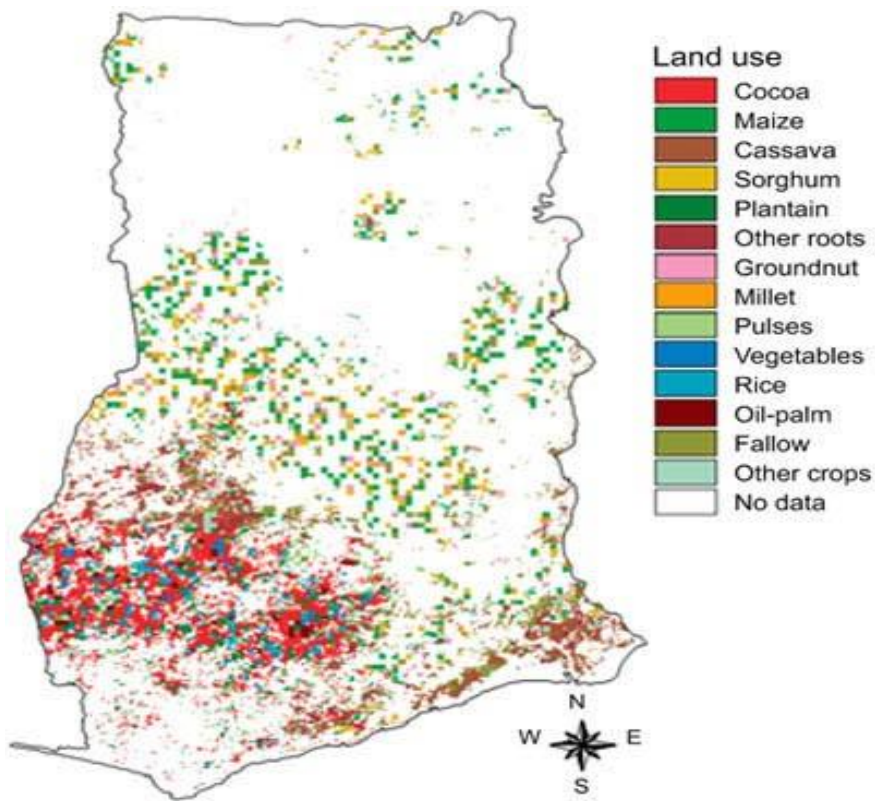
<http://www.who.int/en/>

APPENDIX 1 - Map of Ghana with cities, towns and villages.



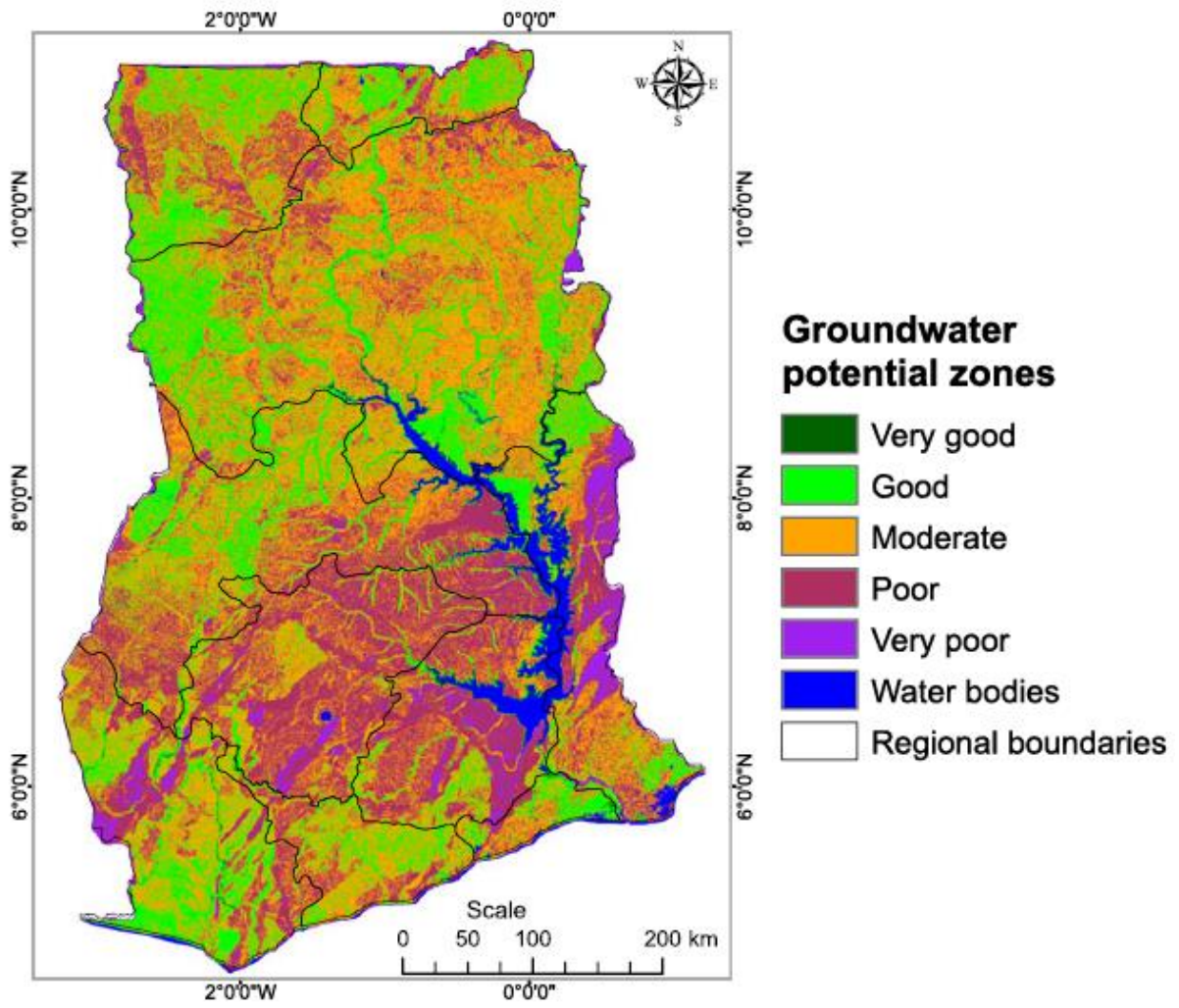
Source: <http://www.infoplease.com/atlas/country/ghana.html>

APPENDIX 2 : Map of Ghana ,depicting fertilizer usage by crop.



Source : <http://www.fao.org/docrep/008/y5749e/y5749e0e.htm>

APPENDIX 3: Map of Ghana showing ground water potential zones cover



Source: <https://research.ncl.ac.uk/amgraf/fieldsites/ghana/>.