UDS International Journal of Development [UDSIJD]
Volume 5 No. 1, June, 2018
http://www.udsijd.org
ISSN: 2026-5336

AN OVERVIEW OF CONSTRAINTS TO SOYBEAN PRODUCTION IN THE NORTHERN REGION OF GHANA

***Mohammed, A-R. S., **Al-hassan, S. and ***Jatoe, J. B. D.**

**Community Life Improvement Programme(CLIP), P. O. Box TL 322, Tamale, Ghana*
***University for Development Studies (UDS), P. O. Box TL 1350, Tamale, Ghana*
**** Department of Agricultural Economics and Agribusiness, 3University of Ghana, Legon,*
**Email: abdul_rashids@ymail.com*

Abstract
This paper investigates the constraints that impede soybean production in the Northern Region of Ghana. The paper describes the trend in soybean production in the Northern Region from 2001 to 2010. It identifies and ranks the constraints to soybean production in the region. Ms Excel was used to plot soybean production figures from 2001 to 2010 sourced from SRID, MoFA. The Kendall's coefficient of concordance (W) model was used to rank the identified constraints impeding soybean production. The results indicate that output of soybean increased from about 36,852MTs in 2007 to about 99,408MTs in 2010 in the study area (about 169.7%). Inadequate farm credit, inadequate rainfall and lack of improved planting materials are the most serious constraints hindering soybean production. The paper recommends that there should be timely delivery of credit in the right amount requested by soybean farmers by the Ministry of Food and Agriculture, SADA and other stakeholders. Quality planting materials should be made accessible and affordable to farmers by Agricultural stakeholders in Ghana.

Keywords: Soybean, Production, Constraints, Trends, Northern Region

Introduction

Soybean thrives well on a relatively well-drained loamy soil with a pH range of 4.5 to 8.5 but performs badly on drought stressed soils and water soaked soils (MoFA, 2006; Dugje *et al.*, 2009). Proper germination of seedlings is assured on a well prepared farm land, which can be done mechanically or manually (Dugje *et al.*, 2009). Improved seeds bought from certified seed dealers are needed to achieve a better germination of soybean on the farm, as they are free from diseases and infestations.

In planting, the crucial roles played by inter and intra row spacing of soybean cannot be soft-peddled. Dugje *et al.* (2009) reported that 5cm intra crop rows and 50cm inter crop rows are advised for both the early and medium maturing varieties. Similarly, intra and inter crop rows of 5cm and 75cm, respectively, are recommended for the late maturing variety. Likewise, the recommended seeding rate for pure stands soybean planting is 3-4 seeds per hole (MoFA, 2006; Dugje *et al.*, 2009).

The recommended chemical fertilizers in soybean production are nitrogen (N) (NPK 15, 15, 15), potassium (P_2O) and phosphorous (K_2O). Even though legumes like soybean fix some amount of nitrogen from the atmosphere through the 'nodules' into the soil, it is important to apply some amount of 'starter' nitrogen to propel the soybean crop growth before nodules start to develop (MoFA, 2006; Dugje et al, 2009). The use of compost manure including, poultry droppings and cow dung, among others, is an excellent source of obtaining higher output in soybean cultivation.

The application of chemical fertilizers or organic manure must be strictly within recommendation. The

per hectare requirements for P_2O, K_2O and N for soybean production are 60kg, 30kg and 25kg, respectively (MoFA, 2006). Dugje *et al.* (2009) on the other hand suggested 40kg per hectare for P_2O, 20kg per hectare for K_2O and 20kg per hectare for N. How much fertilizer is needed for excellent yield achievement is a function of the quality of farm land and the formulation levels of the various chemicals. The most lacking nutrient in soybean production is phosphorous (K_2O) and must be used at 150kg as a single super phosphate fertilizer (SUPA) to augment NPK compound fertilizer of 125kg (Dugje *et al.*, (2009). Fertilization of farm lands should thus, pre-empt seeding for better output to be achieved. This means that fertilizers should be applied before soil is harrowed.

For weeds to be effectively managed in a soybean farm, it is key for small-scale soybean farmers to at least weed their farms twice before the crop reaches its sixth (6^{th}) week or better still, spray the entire farm with pre-emergence herbicide. For medium and large scale farms, the second option is strongly recommended (MoFA, 2006). It is appropriate to do the first and second weeding 2 weeks and 5-6 weeks, respectively, after planting the soybean seeds. The 5-6 weeks after planting is enough time to weed should the farmer prefer the pre-emergence herbicide.

Soybean can be harvested between 3-4 months, when almost 85% and 80% of the pods turn brown (straw-coloured) for the non-shattering and shattering varieties, respectively. Also, at a moisture level of 14%-16% when the seeds are at the hard-dough stage, harvesting can take place manually with a sickle, cutlass or hoe. Excessive delays in harvesting can cause severe lose of yield (Dugje *et al.*, 2009). Harvesting the crop mechanically is well suited at the time when about 90% of the soybean pods are yellow to enable easy threshing and winnowing (MoFA, 2006).

The production technology described above can yield a potential output level of about 4.5 MTs per hectare to soybean farmers who strictly adhere to operational standards. In the Northern Region of Ghana, the average frontier in the 2010 farming season was about 1.97 MTs per hectare (MoFA, 2011). This is far below the potential output level resources can produce and thus, signifies the presence of production inefficiency among soybean farmers.

Problem Statement

In the late 1960s and early 1970s there was an intense research on soybean directed at enhancing both human and animal nutrition by the University of Ghana Agricultural Research Station and CSIR-Crops Research Institute, (Plahar, 2006). This however was short lived as the main objective was not achieved due to poor knowledge of soybean utilization at household level, weak industrial base for soybean processing, production package unattractive to farmers and no market for the crop (Plahar, 2006).

Observing critically, almost all industrial crops are challenged with similar constraints in Ghana. Among these constraints are bad agronomic practices, small scale household cultivations and lack of high-yielding planting materials (MoFA, 2007). For example, pests and diseases, variability of prices, inadequate storage facilities and resource utilization inefficiency have been noted as the challenges affecting maize production in Nigeria (Ojo, 2000). Citing from Nwaru (2004) and Onia (2005), Idiong (2007) revealed that inefficiency in resource utilization is the major challenge affecting farmers, especially small scale farmers in Nigeria.

Furthermore, lack of improved seeds, inadequate credit and inadequate extension contact were highlighted as some of the challenges maize farmers encounted in Ganye local Government Area Adamawa state, Nigeria (Zalkuwi *et al.*, 2010). Chirwa (2003) highlighted land fragmentation as the major disturbing phenomenon for most holders in Malawi. The low output in soybean production is caused both by a lack of significant improvements in technology and poor management techniques in Blitar-East Java (Ananda *et al*, 2003). More so, the diminution of soil nutrients is not an uncommon outcome of unhealthy agricultural practices in major parts of Africa (Smaling 1993). Olujenyo (2008)

indicates that, small scale agriculture has in time past suffered from limited access to credit facilities, modern technology farm inputs and inefficient use of resources in Akoko Land, Ondo-State, Nigeria.

Indeed, low crop yield for cotton production in Pakistan was as a result of high costs of agricultural inputs and unavailability of marketing facilities, rain, manpower and financial facilities (Hassan, 1991). Likewise, it was found by Nabi (1991) that the most constraining variables that negatively affected crop productivity were fertilizer, poor land quality, herbicide costs and irrigation water. Bakhsh *et al*., (2005) showed further that the primary reason for the poor cotton performance in Sargodha (Pakistan) was the early invasion of pests that season. Available literature gives credence to the fact that the agricultural sector has a lower mean technical efficiency level than other sectors in Ghana. For instance, Bhasin & Akpalu (2001) concluded in their study that mean technical efficiency for wood processors, dressmakers and hairdressers were 89, 83 and 76 percent, respectively. Al-hassan (2008) indicated that managerial inefficiency contributed to low technical efficiency levels among sampled rice farmers in Northern Ghana.

Soybean plays an important role in the nutritional and economic development of humans. As a source of protein, the percentage of protein found in soybean is higher than protein sourced from either animals or other plants. The traditional sources of protein also give less in terms of efficacy as compared to soybean. Dashiell (1993) observed that protein sourced from forty-five cups of cow milk or two kilograms of meat or five dozens of eggs is equivalent to protein sourced from just one kilogram of soybean. At the same time its contribution to farmers' welfare is highly significant because increase in farmers' income can with time propel better nutrition (Haddad & Alderman , 2000). FAO (2005) reported that the combination of soybean with any cereal, be it rice, maize, wheat or sorghum provides the standard protein level required by the United Nations for proper human development. There is evidence that continuous consumption of soybean as a cheap source of protein can with time correct the deficiencies in energy and protein needs in Ghana (Plahar, 2006).

It is a source of food for humans, feed for livestock, bio-energy and raw materials for industries (Myaka *et al*., 2005). Dugje *et al.* (2009) summarized the importance of soybean to include a source of excellent vegetable oil, a source of soil fertility enhancement and a source of parasitic weed (*Striga hermonthica)* control. The cake and the haulms by-products are excellent sources of feed for poultry and livestock respectively. Soybean production satisfies three cardinal reasons of crop production as reported by Al-hassan (2008) and Dugje *et al.* (2009). These are production of food to feed the citizenry, production of raw materials to feed industries and production to earn foreign exchange. Finally, the essential nature of the soybean crop to human existence and development can further be seen in the fact that it has dominated the world in the production of oilseeds in the last two and half decades (Smith & Huyser, 1987).

It is essential to recond that soybean production in Ghana serves both domestic and industrial purposes and therefore, identified with the constraints reviewed above. Despite the potential opportunities soybean presents to enhancing farmers' income and standard of living as well as developing three key sectors of the economy, namely agriculture, health and industry (Plahar, 2006), yet no study has been done to investigate the constraints to soybean production in Ghana. This paper, therefore, finds it prudent to investigate the challenges that impede soybean production in the Northern Region of Ghana. The paper describes the trend in soybean production in the Northern Region from 2001 – 2010. It identifies and ranks the constraints to soybean production in the region.

Methodology

Analytical method for the Trend of Soybean Production from 2001 to 2010

The trend of soybean production is presented graphically by using trend analysis. Time series data on soybean production in the Northern Region was sourced from the SRID of MoFA to cover production

figures from 2001 to 2010. The production figures were then plotted on a time series graph by using Ms Excel to show the trend in soybean production in the Region.

Analytical method for Constraints Affecting Soybean Farmers

The Kendall's coefficient of concordance (W) model was used to identify and rank the challenges impeding soybean farming. The model, also known as the Kendall's W is a non-parametric measure employed in the assessment of the level of agreement among different raters or judges (variables, characters, etc.) who are examining a given set of objects (N) (Dodge, 2003; Legendre, 2005; Corder & Foreman, 2009). The model functions best with each rater assigning a range of weights or scores or values or ranks that ranges (from say 1-10) to the constraints facing soybean farmers and each number representing various degrees or magnitudes of the challenges. For instance, 1 and 10 represent the biggest and the smallest challenge, respectively. The Kendall's W is modeled to output a coefficient which ranges from 0-1, whereas, 0 means no absolute agreement, a random response among raters, 1 means absolute agreement (unanimity) among raters and intermediates between the two (0 and1) indicate the degree of greater or lesser agreement (unanimity) among the responses. The Kendall's coefficient of concordance (W) is given as:

$$W = \frac{12S}{p^2(n^3 - n) - pT}; \qquad 0 \le w \le 1 \quad \ldots\ldots\ldots (1)$$

where

S - is the sum of squared deviations for each challenge and is given as:

$$S = \sum_{i=1}^{n} (R_i - \overline{R})^2 \qquad \ldots\ldots\ldots (2)$$

R_i is the total rank for the i^{th} challenge

$\overline{R}$ is the mean value for each total ranked challenge

p - refers to the number of respondents (raters),

n - refers to the number of objects or challenges to be ranked

T - is the correction factor for ties

Sources of Data

Both primary and secondary sources were used to collect data for this paper. Primary data was taken from soybean farmers and secondary data was sourced from MoFA. To this end, time series production data of soybean from 2001 to 2010 reflecting both the participating districts and the Regional level statistics was sourced from the SRID, MoFA.

Sample Size and Sampling Technique

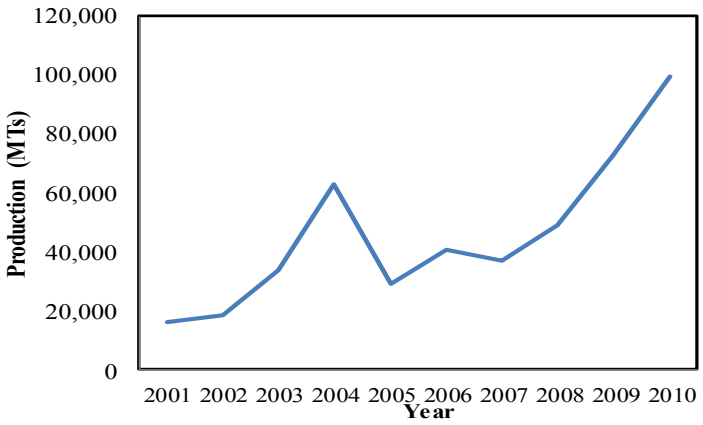
A sample size of 168 soybean farmers was drawn from soybean farmers in the study area. A simple random sampling procedure (lottery method) was used to select 4 districts from the 20 districts in the region. The districts were represented by numbers (1 to 20) written on small pieces of paper and folded, tossed for one minute and 4 out of 20 folded pieces of paper representing 4 districts picked simultaneously by 4 people. The same sampling procedure was adopted to select three communities from each of the 4 selected districts. These are Tolon/Kumbungu District (Nyohindanyili, Gbrimani and Kasulyili), Savelugu/Nanton District (Tibali, Nyoglo and Duko), Yendi Municipality (Gundogu, Kuga and Zang) and Tamale Metrolopolis (Kpenjing, Adubliyini and Lahagu).

Secondly, a systematic random sampling procedure was used to select farmers for the study. Farmers that fell on or represented by even numbers on the sample frame (list) of soybean farmers in each of the three selected communities in the 4 districts were chosen. In all 12 communities were selected and 14 farmers sampled from each of the 12 communities, giving a total of 168 farmers. The systematic random sampling was used because the population of soybean farmers in the study area is homogeneous in terms of characteristics.

Empirical Results

Trend in Soybean Production in the Northern Region

Figure1: Trend in Soybean Production in Northern Region (2001-2010)



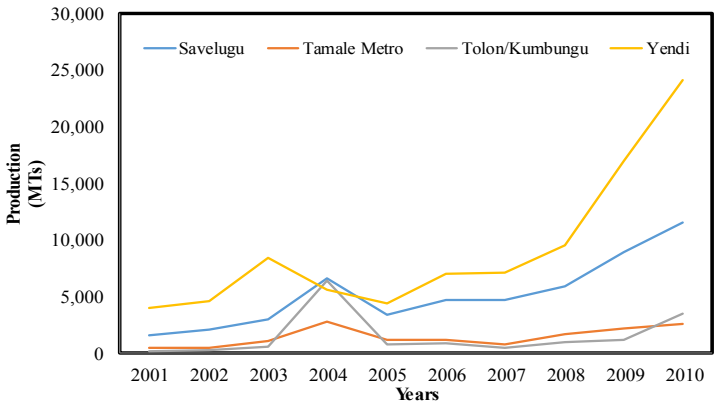
Source: ***Author's construction from SRID of MoFA production figures, 2011***

Figure 1 presents a graph in soybean production in the Northern Region from 2001-2010. The level of production increased marginally by about 16% in 2002 (from about 16,025 MT in 2001 to about 18,577 MT in 2002). Also 2003 and 2004 recorded significant increases in production with about 81% (33,542 MTs) and 88% (63,116 MTs) respectively due to good rain and other favourable farming conditions for those cropping seasons. However, soybean production dipped by about -54% (63,116 MTs to 29,096 MTs) in 2005 due to poor rain and unfavourable farming conditions (MoFA, 2006). Since then, there has been a sustained increase in soybean production from about 36,852 MTs in 2007 to about 99,408 MTs (about 170%). The overall growth of soybean in the study area over the 2001 to 2010 period was about 520.31%.

The impressive gains in soybean production (49%) in the 2009 and (37%) in 2010 seasons can be attributed to the increasing awareness about the importance of soybean production and consumption in the rural areas of Ghana. The success story is the result of increasing campaigns by NGOs and other stakeholders who work in promoting glut in production, good nutrition and healthy living of Ghanaian rural folks.

Trend in Soybean Production in Four Selected Districts

Figure 2: Trend in Soybean Production in Four Sampled Districts in the Northern Region (2001-2010)



Source: Author's construction from SRID of MoFA production figures, 2011

The trend in soybean production in the four sampled districts in the region is presented in Figure 2. Tolon/Kumbungu district and Tamale Metropolis represent the districts in the Region with low levels of soybean production. The two geographic areas witnessed an increase in production by about 300% and 165% in 2003 from about 120 MTs and 384 MTs in 2001 respectively. The year 2004 also saw a record increase in soybean production where Tolon/Kumbungu district and Tamale Metropolis both increased production levels by about 1,233% and 168% from the 2003 output levels of about 480 MTs and 1.020 MTs, respectively. Apart from a dip in production in 2005 which was caused generally by rain failure, Tolon/Kumbungu district and Tamale Metropolis had a sustained rise in production by about 693.3% and 277.1% in 2010 from about 431 MTs and 673 MTs in 2007 respectively.

The other two districts, Savelugu and Yendi (also in Figure 2) reflect the high soybean producing areas in

the Region. There has been a sustained increase in production in both Savelugu and Yendi districts from 2001 to 2003. The year 2004 saw a dip in production level in Yendi by about -34% from the 2003 production level of 8,400 MTs. Savelugu however, saw a substantial increase in production by about 122% in 2004 from 2,970 MTs in 2003. Notwithstanding the general production failure in 2005 which was attributed to inadequate rainfall, the two districts gained a phenomenal and sustained rise in production from about 4,649 MTs and 7,056m MTs in 2007 to about 11,524 MTs and 24,148 MTs in 2010 respectively. These represent an increase of about 147.9% and 242.2% for Savelugu and Yendi districts during 2007 to 2010 respectively.

Considering the two groups of districts, high and low soybean producing districts in the Northern Region, one would say that the high producing (Savelugu and Yendi) districts have performed well in terms of absolute production figures of soybean from 2007 to 2010 but the low producing (Tolon/Kumbungu district and Tamale Metropolis) districts have fared better in terms of % change in production from 2007 to 2010. For instance, Tolon/Kumbungu district and Tamale Metropolis increased production by about 693.3% and 277.1% during 2007 to 2010 respectively, as compared to about 147.9% and 242.2% for Savelugu and Yendi districts during 2007 to 2010, respectively.

Challenges facing Soybean Farmers

Ten challenges were identified as key constraints facing soybean farms in the study area. These were ranked by the farmers in Table 1. In ranking these challenges, it is envisaged from the Kendall's coefficient of 0.40 that there was rather a weak agreement among soybean farmers regarding what really was their most serious constraint in production. The three most constraining challenges impeding soybean farming in the region are: inadequate farm credit which has a mean of 2.06, inadequate rainfall with a mean of 3.10 and lack of improved planting materials with a mean of 4.86. The last three constraints impeding soybean farming are: post-harvest losses, inadequate storage facilities and poor road network and their mean values are 6.96, 7.09 and 7.68, respectively.

Even though there is a weak agreement in the ranking process by soybean farmers, inadequate farm credit tends to have the highest mean and therefore becomes the most serious constraint in soybean farming in Northern Region. This is consistent with the findings of Zalkuwi *et al*. (2010) in Ganye Local Government Area Adamawa state, Nigeria.

Table 1: Ranked Challenges of Soybean Farmers

Challenges	Mean Rank	Ranking
Inadequate farm credit	2.06	1st
Inadequate rainfall	3.10	2nd
Lack of improved planting materials	4.86	3rd
Low price of soybean	5.37	4th
High cost of labour	5.45	5th
Pests and Diseases	5.68	6th
Lack of market	6.74	7th
Post-harvest loses	6.96	8th
Inadequate storage facilities	7.09	9th
Poor road network	7.68	10th

Source: Field Survey, December 2011

Conclusions and Policy Recommendations

There has been a consistently impressive growth in the production of soybean in the Northern Region especially, from 2007 - 2010. However, the rate of growth in production, which was about 49%, 37% and 170% for 2009, 2010 and 2007-2010, respectively, is still slow and steady when compared with other places like Benue State of Nigeria. The implication is that there is still room for good production performance (growth) in the study area. With a Kendall coefficient of 0.40, soybean farmers were not unanimous with regards to their major constraints in soybean production but the three most serious constraints were identified to be inadequate farm credit, inadequate rainfall and lack of improved planting materials. The three most serious constraints facing soybean production in the region are inadequate farm credit, inadequate rainfall and lack of improved planting materials. The collective impact of these is the low level of soybean yield per hectare in the study area.

There is the need for farmers, government and other stakeholders to increase the level of resource commitment into the cultivation of soybean so as to sustain the increasing trend especially, from 2007 to 2010. Also, low soybean producing areas like Tolon/Kumbungu and Tamale Metropolis should be encouraged to produce more soybean. There should be timely delivery of credit in the right amount requested by soybean farmers by the Ministry of Food and Agriculture, SADA and other stakeholders. Easy access to farm credit facilitates the adoption and use of new farm technologies and hence increases agricultural productivity and quality planting.

References

Al-hassan, Seidu (2008). Technical Efficiency of Rice Farmers in Northern Ghana. ***AERC Research Paper 178. African Economic Research Consortium****, Nairobi* April 2008.

Ananda, C. F., Arisudi, A., Suprapto, E. & Waluyowati, N. P. (2003). ***The Competitiveness of Soybean Production in Blitar-East Java***. Malang June 2003.

Bakhsh, K., Ishtiaq, H. & Asif, M. (*2005*). Factors Affecting Cotton Yield: A Case Study of Sargodha (Pakistan). ***Journal of Agriculture and Social Sciences.*** *1813–2235/2005/01–4–332–334.* (http://www.ijabjass.org)

Bhasin, V.J. & W. Akpalu (2001). Impact of Micro-Finance Enterprises on the Efficiency of Micro-Enterprises in Cape Coast**.** ***Impact of Financial Sector Liberalization on the Poor (IFLIP) Research Paper 01-5***. *International Labour Organization, Geneva*

Chirwa, Ephraim W. (2003). Sources of Technical Efficiency Among Smallholder Maize Farmers in Southern Malawi. ***Wadonda Consult Working Paper WC/01/03*****.** University of Malawi Chancellor College, Department of Economics. (*E-mail: echirwa@yahoo.com)*

Corder, G.W. & Foreman, D.I. (2009). ***Nonparametric Statistics for Non-Statisticians: A Step-by-Step Approach.*** Wiley, ISBN 9780470454619

Dashiell, K. E. (1993). ***Soybean Production and Utilization in Nigeria***. Paper Presented at the National Workshop on held at IITA, Ibadan, Nigeria.

Dodge, Y. (2003). ***The Oxford Dictionary of Statistical Terms***. OUP. *ISBN 0-19-920613-9*

Dugje, I.Y., L.O. Omoigui, F. Ekeleme, R. Bandyopadhyay, P. Lava Kumar1, & A.Y. Kamara (2009). ***Farmers' Guide to Soybean Production in Northern Nigeria***. International Institute of Tropical Agriculture (IITA). Ibadan, Nigeria.

Dugje, I.Y., L.O. Omoigui, F. Ekeleme, R. Bandyopadhyay, P. Lava Kumar1, & A.Y. Kamara (2009). ***Farmers' Guide to Soybean***

Production in Northern Nigeria. International Institute of Tropical Agriculture (IITA). Ibadan, Nigeria.

FAO (2005). Food and Agriculture Organization Publication, various issues.

Haddad, L. & Alderman, H. (2000). Eradicating malnutrition: Income growth or nutrition programmes? The Life Cycle of Malnutrition. ***International Food Policy Research Institute,*** New York.

Hassan, I. (1991). ***Determination of factors inhibiting adoption of improved technology in cotton production***. M.Sc. (Agric. Econ.) Thesis, University of Agriculture, Faisalabad, Pakistan

Idiong, I.C. (2007). Estimation of Farm Level Technical Efficiency in Smallscale SwampRice Production in Cross River State of Nigeria: A Stochastic Frontier Approach. ***World Journal of Agricultural Sciences*** 3 (5): 653-658, 2007. ISSN 1817-3047. Department of Agricultural Economics and Extension, University of Calabar, Nigeria, P.M.B. 1115, Calabar, Nigeria.

Legendre, P. (2005). The Kendall Coefficient of Concordance Revisited. ***Journal of Agricultural, Biological and Environmental Statistics***, 10(2): 226–245.

Ministry of Food and Agriculture (MoFA) (2011). ***Agriculture in Ghana Facts and Figures (2010)***. Statistics, Research and Information Directorate (SRID), Accra

Ministry of Food and Agriculture (MoFA) (2006). Statistics, Research and Information Directorate (SRID), Accra

Ministry of Food and Agriculture (MoFA) (2006). ***Agricultural Extension HandBook. Evidence from Rural Household Survey Data, Agricultural Economics, Agronograph***. First published by Ghanaian-Germany Agricultural Development project (GTZ). 16. ASA, CSSA, and SSSA, Madison.

Ministry of Food and Agriculture (MoFA) (2007). ***Food and Agriculture Sector Development Policy*** (FASDEP II). August 2007.

Myaka, F. A., Kirenga, G., & Malema, B. (Eds) (2005). Proceedings of the First National Soybean Stakeholders Workshop", 10–11 November 2005, Morogoro, Tanzania.

Nabi, M. (1991). Relationship between crop productivity and input usage. ***Journal of International Development***. 8: 68–88

Nwaru, J.C. (2004). Rural credit markets and arable crop production in Imo State of Nigeria.

Ojo, S.O. (2000). Factor Productivity in Maize Production in Ondo state, Nigeria. ***Applied Tropical Agriculture*** 15(1): 57-63.

Olujenyo, F. O. (2008). The determinants of Agricultural Production and Profitability in Akoko Land, Ondo-State, Nigeria. Department of Sociology, Adekunle Ajasin University, Akungba Akoko, Ondo State, Nigeria

Oniah, M. (2005). ***Analysis Resource Use efficiency of Swamp rice farmers in Cross River state of Nigeria***. Unpublished MSc Thesis, University of Calabar

Plahar, W. A. (2006). Workshop on Soybean Protein for Human Nutrition and Health Accra, Ghana. Director of CSIR-Food Research Institute, 28th September, 06.

Smaling, E.M.A. (1993). Soil nutrient depletion in sub-Saharan Africa". In H. van Reuler and W.H. Prins (eds***.), The Role of Plant Nutrients for Sustainable Food Crop Production in Sub-Saharan Africa.*** Leidschendam, The Netherlands: VKP (Dutch Association of Fertilizer Producers).

Smith, K & Huyser, W. (1987). World distribution and significance of soybean. In J.R. Wilcox (Ed.) ***Soybean: improvement, production, and uses***. Third Ed.

Zalkuwi, J. W., Dia, Y. Z. & Dia, R. Z. (2010). Analysis of Economic Efficiency of Maize Production in Ganye local Government Area Adamawa state, Nigeria. ***Report and Opinion 2010*** *2(7):1-9.*