UNIVERSITY FOR DEVELOPMENT STUDIES

FARMERS' WILLINGNESS TO PAY FOR SOYA BEAN PRODUCTION INPUTS IN NORTHERN GHANA

GYAN, KWASI

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BY

GYAN, KWASI

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A THESIS SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL EXTENSION RURAL DEVELOPMENT AND GENDER STUDIES, FACULTY OF AGRIBUSINESS AND COMMUNICATION SCIENCES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHILOSOPHY IN INNOVATIONS COMMUNICATION

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DECLARATION

Student

I, Kwasi Gyan, author of this thesis do hereby declare that except for various forms of related literature consulted and which have been duly acknowledged, the entire work was done by me in the Department of Agricultural Extension, Rural Development and Gender Studies, University for Development Studies (UDS). This work has never been submitted either in whole or in part for any other degree in this University or elsewhere.

Signature: --------------------------------- Date: --------------------------

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Supervisors

We hereby declare that this thesis was carried out by Mr. Kwasi Gyan in partial fulfilment of the requirements for the award of Master of Philosophy (Mphil) Degree in Innovations Communication under our supervision in accordance with the guidelines on supervision laid down by the University for Development Studies.

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ABSTRACT

Crop production in Ghana is confronted with factors such as decreased farm lands, soil infertility, reduced cropping season resulting from a diminishing rainfall pattern, use of poor quality seeds leading to low crop yields. Quality agro inputs significantly enhance crop productivity when employed in the production process. In Ghana, soya bean has attracted much attention, but little is known about the willingness of its producers to pay for agro-inputs hence the necessity for this study.

Based on this, a total of 400 soya bean farmers were used in a proportionate random sampling using primary data sourced through personal interviews using semi structured questionnaires, focus group discussions and key informant interviews. The study revealed that, every GH¢1 invested will yield an interest of 76%. The three major challenges found from the study were drought, difficulties in harvesting and threshing as well as access to tractor services for ploughing, especially for women. Seventy-four percent (74%) of the respondents were willing to pay as against 26% who were not willing to pay for the soya production inputs. It was also revealed that factors such as age, household size, access to credit, participation in demonstrations and gains made from farmer demonstration field schools were statistically significant for certified soya bean seeds. The significant factors on Glyphosate included household size, purpose and experience in soya bean production. In the case of TSP fertilizer access to extension, participation and gains from farmer demonstration field schools and distance to the nearest agro input market were the determinants. The use of inoculant was influenced by age, access to credit, participation in demonstration, farmer group membership and experience in soya production. Policy towards dissemination of early maturing varieties and subsidies on soya bean inputs are recommended.

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DEDICATION

This work is dedicated to Prof Samuel Adjei-Nsiah and his family.

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LIST OF ACRONYMS

TSP - Triple Super Phosphate

IFAD – International Fund for Agricultural Development

USD - United States dollars

MoFA- Minisrty of Food of Agriculture

MoTI – Ministry of Trade and Industry

FAO- Food and Agricultural Organisation

USA- United States of America

IITA- International Institute of Tropical Agriculture

NDSU- North Dakota State University

CIMMTY- International Maize and Wheat Improvement Centre

DANIDA- Danish International Development Agency

USDA- United States Department of Agriculture

AGRA- Alliance for a Green Revolution in Africa

SRID - Statistics, Research and Information Directorate

METASIP-Medium Term Agricultural Sector Investment Plan

SADA - Savannah Accelerated Development Authority

IGC- International Grain Market

GROW- Greater Rural Opportunities for Women

RR Soya - Roundup Ready Soya

LL - Liberty-Link

MEDA- Mennonite Economics Development Associates

WTP- Willingness to pay

NWTP –Not willing to pay

IFDC - International Fertilizer Development Center

GAABIC-Ghana Agricultural Associations Business Centre GI- Gross income

AVCMP - Agricultural Value Chain Mentorship Project

TC- Total Cost

NRGP - Northern Rural Growth Program

TVC- Total Variable Cost

NGOs – Non Governmental Organisations

CHAPTER ONE

INTRODUCTION

1.0 Background to the study

Ghana's economy over the years has largely depended on traditional export such as cocoa, coffee, as well as gold and timber. However, research has shown that, diversification into non-traditional crops is profitable and an alternative for bringing about sustainable growth (in net importing countries) or for increasing export earnings (Diao et al., 2003). This has propelled the non-traditional crop sector to give soya bean production an increasingly attention in Ghana's agriculture. The government of Ghana through Ministry of Food and Agriculture (MoFA), Non-Governmental Organisations (NGOs) and other development partners are all promoting the production of this crop to enhance household nutrition and cash income for producers (Mbanya, 2011), especially in the Northern Ghana where both soils and climatic conditions are favourable for the production of the crop. Dogbe et al., (2013) further asserted that, most agricultural interventions in Northern Ghana, such as Youth in Agriculture Programme, Northern Rural Growth Program (NRGP), Savannah Accelerated Development Authority (SADA), Alliance for a Green Revolution in Africa (AGRA) projects, Danish International Development Agency (DANIDA), United States Agency for International Development (USAID) projects, and many others, focus on promoting the production and utilization of the soya bean through value chains.

Soya bean is a multipurpose crop and serves as a source of human food, livestock feed, industrial raw material, and more recently, as a source of bio-energy (Myaka et al., 2005).According to the Statistics, Research and Information Directorate, (SRID) of the Ministry of Food and Agriculture (MoFA, 2012), majority of soya bean produced in

Ghana emanates from the Northern Ghana and Northern region alone accounts for about seventy-seven per cent (77%) of the national production. The region is therefore a target for most soya bean related interventions including the Agricultural Value Chain Mentorship Project (AVCMP), funded by DANIDA through AGRA which was jointly implemented by CSIR-SARI, International Fertilizer Development Center, (IFDC), and Ghana Agricultural Associations Business Centre, (GAABIC).

According to Sherry-Lee (2010), soya bean value chain cuts across all investment areas that is, staple foods used in variety of dishes, cash crop with local and international demand and as raw material for emerging oil and feed industries. This is primarily because soya bean presents a multidimensional value proposition for smallholder farmers: income from soya produced as a cash crop, substituting imports in evolving local and growing international markets; and increased yields in both cash and food rotation crops, benefitting from the nitrogen fixation properties of soya bean.

Soya bean grain contains more than 36% protein, 30% carbohydrates, and an excellent amount of dietary fibre, vitamins, and minerals. The beans contain 30% cholesterol free oil, about 40% protein and other important vitamins for human health (El Agroudy et al., 2011). It is also a potential vegetable oil crop and has about 30% amount of oil, which has undoubtedly resulted in the establishment of some agro industries to process the crop for edible oil while the by-product is used in the formulation of animal feed especially for poultry. Demand for soya bean and soya bean products outstrips production in Africa and for that matter Ghana. This creates the need to import the soya bean from outside the country, predominantly soya bean cake for animal feed, but also for oil, meal and soya-derived products. Currently, while the domestic production in Ghana stands at about

141,469 metric tons of soya bean grain annually. Total domestic demand for cooking oil, seasoning and animal feed cake is estimated at nearly 182,083 metric tons per year (USAID, 2013) leaving a shortfall of about 40,600 tons. In 2015 alone, about 27, 488 tons of soybean and soya bean products was imported into the country with an estimated value of about fifty five million United States dollars (USD 55,000,000) of which 84% was oil cake (MoTI, 2016). Soya bean cake (a by-product from processed soya) is used in the formulation of animal feed especially for poultry (Plahar, 2006) in Ghana and is comparatively cheaper than fish meal.

In Ghana, soya bean is mainly produced by smallholder farmers under rain-fed conditions. Using this system of production, soya bean yields an average of 0.8 metric tons per hectare. Meanwhile, research has shown that soya bean has a yield potential of 4.5 metric tons per hectare under the best commercial agricultural practices in Ghana. This however require the application of appropriate agro inputs (IFAD, 2009). Chianu (2009) reported that, the use of improved soya bean seeds, which were mostly sourced from certified seed companies and research institutes, significantly contributed to rapid increase in production as well as yield. Crop rotation of soya with maize on smallholder farms results in improved soil fertility on fields with multiple crops per year.

Protein deficiency is reportedly high in many parts of the country, while animal protein sources are too expensive for most people. In comparison to other legumes which provide some protein, soya bean protein is cheaper and of a higher quality. Soya bean seed contains protein that is higher than that of meat, poultry and eggs and is the only legume that contains all the essential amino acids (Shalma, 2014) required for healthy growth and vitality.

Soya bean is relatively new and can receive favourable resource allocation (agro inputs and credit) only if its various superior attributes over other grain legumes and common sources of protein (meat, fish, and others) are clearly demonstrated. The studies by Yeng et al., (2013) in Shanghai and Japan have found that soya bean consumption can reduce risk of developing both Coronary Heart Disease (CHD) and stroke. One of such diseases is the type 2 diabetes which is also associated with an increased risk of developing cancer. In the search of ways and methods to combat cancer, Shu et al., (2009) and Guha et al., (2009) reported that soya bean consumption stands tall to decrease re-occurring cancer and death and Symolon et al., (2004) attributed this to the high glucosycermide content in soya bean.

Soya bean like other legumes has the potential to improve soil fertility through atmospheric nitrogen fixation (Kasasa et al., 2000; Sanginga et al., 2003). The quality of the crop has the ability to mitigate the declining soil fertility condition in Ghana which is a challenge to food production. Therefore, the fear of meeting the food needs of increasing urban dwellers, and in the face of high fertilizers cost will be reduced for farmers when used in rotation with cereals such as maize. The crop has the capability of trapping atmospheric nitrogen through rhizobia in the nodules. However, on soils that have not been used for soya production in immediate past year, inoculation of the seed with specific Bradyrhizobia strains (Inoculants) are necessary for effective nitrogen fixation (Darryl et al., 2004). The nodulation can be enhanced by the use of inoculant containing certain species of rhizobium bacteria specific for soya bean on the seeds or soil prior to planting. Inoculant is either a liquid, powdered or granular peat-based substance containing rhizobia bacteria (Bradyrhizobia japonica) which helps to ensure adequate nodulation in legumes (NDSU, 2013).

Studies by Cliff, (2000), Kamanga *et al*., (2010) and Kamara*et al.*,(2007) have shown that phosphorus (P) fertilizers can increase soya bean yields. Rotation with other highly fertilised crops and seed inoculation lower the ratio of the nutrients to be added to the soil. But in actual sense, few farmers apply chemical fertilizers to their soya bean crop. Based on its ability to trap atmospheric nitrogen, studies have shown that farmers do not see the need to fertilize soya bean especially once there is good nodulation (Albareda et al., 2009). But it is noted by Rhode, (1995),Xu et al., (2009) and Smaling et al., (2006) that most farmers in Africa and for that matter Ghana use less fertilizers than the recommended rates. This is attributed to the lack of information on fertilizer use, risk averse in the current climate changing situation where rainfall is not reliable, lack of cash to pay for it because of low cash income and a poorly functioning credit market where farmers lack collateral security (Dogbe et al., 2012).

There is global concern of meeting food and fibre demand the rising human and animal population (Wegner and Zwart, 2011). Seed initiatives are also commonly presented as a prime driver for modernizing smallholder agriculture, with the assertion that the use of improved seed (i.e. certified seed of improved varieties), coupled with fertilizers, will result in higher yielding and more efficient production environments (Sperling and McGuire 2012). This requires for accelerated use of science and technology in agricultural production. The era of technological adoption has significantly transformed soya bean production in some parts of the world and these technologies have their associated agro inputs. For example Roundup Ready (RR Soya) and Liberty-Link (LL) soya bean varieties in the North and South America (Whitaker et al., 2013; Swanby 2010;Goldfarb and Zoomers, 2013), which are resistant to herbicides. Conversely where technological use is limited, poor smallholder farmers resort to extensification to compensate for low crop yields (Jabbar et al., 2000).MoFA (2010) confirms that agricultural growth achieved over the past decade were through land area expansion as opposed to yield increases per unit area of land. To achieve a sustained growth in agricultural productivity among smallholder farmers; the application of appropriate agro inputs cannot be under-estimated. Balmford et al., (2012) observed that, there is an increased growth of competing demand for water and land resources for agriculture and other development such as urbanization, industry and power generation. Therefore, increased food production through large tracts of land will not be feasible in the future.

Studies have shown that, the shift of the labour force towards urban centres due to rural-urban migration also aggravates the problem of food production and supply shortages as opposed to high demand for food same both in rural, peri-urban and urban communities (Oti-Agyekum, 2015 and Goldsmith et al., 2004). This problem can only be addressed when there are planned interventions in the agricultural sector desirable or attractive enough to the youth to enter into.

In addition, climatic variability of recent years resulting in erratic rainfall patterns, shorter cropping seasons, prolonged drought conditions and excessive rise in temperatures have all necessitated the application of technologies in soya bean production, which have their associated agro inputs (Lybbert and Sumner, 2010). Are farmers ready to pay for these inputs?

This study seeks to assess farmers' willingness to pay for agro inputs and the factors that influence their interest in soya bean production

1.1 Problem statement

Soya bean forms root nodules which contains a bacteria called rhizobia to enhance biological nitrogen fixation. To form root nodules and fix atmospheric nitrogen, soya bean needs this specific bacteria. However, in most soils, this bacteriummay not be in abundance hence farmers require inoculate the seeds or the soil with the appropriate bacteria before planting. Inoculation is the process of coating the seed or soil with the inoculum or inoculants prior to planting to enhance nodulationm. The soya bean inoculum or inoculant is either a liquid, powdered or granular peat-based substance containing the rhizobia bacteria (*Bradyrhizobia japonica*) which helps to ensure adequate nodulation in legumes (NDSU, 2013).

It is observed that most projects such as N2Africa receive maximum attention from farmers during implementatipon especially when inputs and other support services are freely provided. Once the project expires and the supply of inputs is terminated, farmers resort to their old practice or even abandon the production technology of that particular crop completely. Small-scale soya bean farmers, unlike large-scale commercial farmers, depend little on agro-inputs such as fertilizer, herbicides, inoculant and insecticides for increasing production (Cline, 2007; Mbanya, 2011).

Agriculture in Ghana is dominated by small scale farmers, known to be associated with low income levels (Yawson et al., 2010).These small-scale farmers take advantage of the fact that soya bean, being a legume, supports bacteria that supply nitrogen to the soil; moreover, inputs such as insecticides, certified seeds, inoculant, P fertilizers and herbicides are very expensive. Following this, the N2Africa Project (www.n2africa.org) demonstrated to farmers through on-farm activities the benefits on the use of soya bean inoculants, certified seeds, TSP fertilizer (Triple Super Phosphate) and herbicides to some soya bean farmers in northern Ghana since 2014. While many farmers have seen the benefits associated with these inputs which were reflected in the grain yield at harvest during on-farm demonstrations, accessibility to these inputs in rural markets in Northern Ghana has been a challenge. Agro-input dealers are largely not willing to sell grain legume inputs because of a perceived lack of demand for these inputs. In a study to assess agro-input dealers willingness to invest in inoculant production, Martey*et al*. (2016) reported that the willingness to invest in legume inoculant production was relatively high among agro-input dealers and that agro-input dealers who had access to financial institutions were 36 percent more willing to intensively invest in legume inoculants as compared to those without access to financial sources. However, the willingness of farmers to pay for soya bean inputs including rhizobium inoculant is not known.

This study therefore seeks to assess farmers' willingness to pay for soya bean inputs in Northern Ghana, as they do for the inputs of other crops such as maize, rice and vegetables.

1.2 Research Questions

1.2.1 Main Research Question

The main research question of the study is: are Ghanaian farmers willing to pay for agro-inputs for soya bean production?

To be able to answer this question, the research seeks to find answers to the following specific questions

1. What agro-inputs are farmers presently using for soya bean production?
2. What costs and benefits are derived by farmers in soya bean production?
3. What are the challenges of farmers in soya bean production?
4. What are the factors influencing farmers' willingness to pay for agro inputs for soya bean production in Northern Ghana?

1.2.2 Research objectives

The main objective of the research is to determine whether farmers' in Northern Ghana are able and willing to pay for agro-inputs for soya bean production and why

Specifically, the research sought to achieve the following objectives

1. To examine farmers current agro–inputs application to soya bean production in Northern Ghana
2. To assess the profitability level of soya bean production in the study area
3. To identify the challenges of farmers in soya bean production
4. To determine the effect of factors influencing willingness to pay for soya bean inputs in Northern Ghana

1.3 Justification

The national agricultural policy of Ghana since independence has focused on the modernization of the agricultural sector which involves the use of appropriate technologies such as machineries and agro inputs. This according to Abebe and Bogale (2014) aims at changing the country's subsistence or traditional agriculture to a commercial or market oriented one, by in order to increase the demand for goods and services and further lead to an industrial development. Policy makers have targeted this orientation as a way of reducing importation of agricultural products which drains the country's foreign reserves with a negative impact on foreign exchange rates.

In spite of numerous literatures on soya bean production little information exists on farmers' willingness to pay for agro inputs in soya bean production in Ghana. Consumer perceptions are vital indicators to success in both new and existing markets and for setting optimal price strategies (Balderjahn, 2003). Therefore, a study of the farmer perspectives on willingness to pay for agro inputs is significant for several reasons. First ascertaining the views of farmers on agro inputs will reveal the kind of inputs applied in soya bean production. This will add to empirical knowledge on soya bean production technologies for future projects. Research and Agricultural extension will be informed on the adoption of agricultural technologies; in this case agro inputs and also identify other opportunities for disseminating appropriate message on inputs use in soya bean cultivation. Also, the stakeholders in the supply chain of agro inputs (manufacturers, distributors, wholesalers and retailers) will be well informed about the demand and willingness to pay for agro inputs in soya bean production and the kind of agro inputs to make available to farmers. The research will also provide policy makers with relevant information to formulate suitable policies on agro inputs availability and distribution that will enhance soya bean production in Northern Ghana and the country at large. Also, the study will provide researchers with empirical knowledge that will enhance further research.

1.4 Organisation of the Thesis

This thesis is organised into five chapters. Chapter one presents an introduction of the study while chapter two gives a review of relevant literature. In chapter three, the methodological frameworks are presented while chapter four gives the empirical results and discussions of the study. The final chapter presents the summary, conclusions and recommendation towards policy formulation.

CHAPTER TWO

LITERATURE REVIEW

2.0: Introduction

This chapter reviews past and relevant studies undertaken by other researchers. The reviews are on soya bean inputs sector, adoption and factors influencing producers' willingness to pay for the inputs in soya bean production and also on methods of analysis frequently used in willingness to pay and adoption studies

2.1 Soya Bean Production Worldwide

Among the legumes that have accelerated in its global production is soya bean. The accelerated production is due to diverse andnutritive value for growing human and animals populations. This is also attributed to job creation along value chains, income generation, and its ability to restoring the declining soil fertility when grown in rotation with cereals among other benefits. Current world production of soya bean is 319 million metric tons of grain per annum, of which the seven leading producers are the United States of America (USA)-32%, Brazil-28%, Argentina-21%, China-7%, India-4%, Paraguay-3%, Canada-1% and others-4% (USDA, 2015). According to USDA report for 2015, total land area under soya bean cultivation in the world was 118 million hectares per annum and total foreign production (outside USA) was 212.6 million tons annually. The three major producing countries were USA 29, Brazil 23, and Argentina 14 million hectares of land area under soya bean production (IITA, 2009). International Grain Council –IGC (2015) reported the world production of soya bean for 2014/2015 as 321.1 million metric tons. The source revealed the three leading producers as the USA (106.9), Brazil (86.1) and Argentina (61.4)

The U.S. is projected to increase soya bean production by 19% extra to its present 32% by 2022. However, its production growth will be limited because of land constraint but, Argentina and Brazil are expected to increase their soya bean production by 38% and 25%, respectively (Taylor and Koo, 2013). They have the capacity to convert range and pastures into arable lands for soya bean cultivation compared to America.

Also, Masuda and Goldsmith (2008) reported that global soya bean production stood at 94 million hectares and further outlined that U.S.A. accounted for over 30 million, Brazil 22 million, Argentina 15 million, China 9.2 million, India 8.2 million, Paraguay 2.2 million and Canada 1 million hectares. In relation to Sub-Saharan Africa, they showed that, soya bean production was around 1.16 million hectares with an average output of 1.26 million tons of grain in 2005.

2.2 Africa's Contribution to Soya Bean Production

African countries with the largest area of soya beans production were Nigeria (601 000 hectares), South Africa (150 000 hectares), Uganda (144 000 hectares), Malawi (68 000 hectares), and Zimbabwe (61 000 ha) (Oyatokun and Oluwasemire, 2014). Other countries with significant production include Rwanda (42 160 ha), DRC (30 000 ha), and Zambia (15 000 ha). Zambia produced 112,000 metric tons of soya beans in 2010 and processed 90,000 metric tons in the same year. Zambia is largely self-sufficient in soya bean production. Of the soya bean supply, 85% comes from commercial farmers, characterized by high use of inputs, use of irrigation, and fairly high yields of more than 2.9 metric tons per hectare (Zambia Daily Mail Limited, 2016). Only 2% of soya bean supply in 2010 came from imports. The processing sector has an installed crushing capacity of roughly 125,000 metric tons, currently more than enough for domestic demand, making Zambia a self-sufficient country in soya bean production. It was also observed by Shurtleff and Aoyagi (2009), that in the year 2007, Nigeria, South Africa, Uganda, Zimbabwe and Egypt were found to be the leading soya bean producers in Africa. Going by the 2008-2009 records, Nigeria is still the highest Africa's soybean producer (39%), closely followed by South Africa (35%) while Uganda is the third highest African producer (14%).

2.3 Soya Bean Production in Ghana

In Ghana, soya bean was introduced in 1909 during the colonial era by the Portuguese (Mercer-Quarshie and Nsowa, 1974; Plahar, 2006 and Osman, 2011). This was to enhance human nutrition where farmers grow the crop as an additional food item and a raw material for export (Mercer-Quarshie and Nsowa, 1974; Plahar, 2006 and Osman, 2011). In 1970s, there was strong collaborative breeding initiative between Ministry of Food and Agriculture and IITA to revamp soya beans production (Tweneboah, 2000). Currently, soya bean has attained commercial status and is being grown as a cash and staple crop in Ghana. National output from domestic production was estimated at about 145,935 metric tons of soya bean grain annually and import of 200 metric tons (MoFA , 2010), to supplement domestic production. Fifty (50) metric tons was reported as export, given an impression that Ghana has the potential to expand its production and export. In 2005, the annual estimated area under soya bean production was about 8,000 to 10,000 hectares in Ghana (Dapaah et al., 2005). This has grown to about 76,000 hectares (USAID, 2012). Most of the soya bean production activities occur in the transitional zone and northern Ghana. Mbanya, (2011) reported that Northern region accounts for seventy-seven per cent (77%) of the national production.MoFA reported 76,000 hectares of soyabean production in 2010 with more than half of that in the Northern Region.

The average yield of soya bean in Ghana increased from 1.3 to 1.5 metric tons per hectare between 2000 and 2010 respectively (Tweneboah, 2000; MoFA, 2010), and is above Africa's average of 1.1 tons per hectare (IITA, 2009). Under subsistence production system soya bean in Ghana will yield an average of 0.8 metric tons per hectare and this can be raised to about 4.5 metric tons when best commercial production practices are employed MiDA (2010). In comparison with other countries average, for instance Argentina (2.76), the USA (2.96), South Korea (1.93) and Brazil (2.88) tons per hectare (USDA, 2015), Ghana's average yield per hectare is low. Therefore, application of appropriate technologies in soya bean production is a vital decision for farmers to consider.

2.4 Definition and meaning of Adoption

Adoption has been defined in many ways by different authors. Loevinsohn et al., (2013) define adoption as the integration of a new technology into existing practice and is usually proceeded by a period of 'trying' and some degree of adaptation. Bonabana-Wabbi (2002) defined adoption as a mental process an individual passes from first hearing about an innovation to final utilization of it. Adoption is in two categories; rate of adoption and intensity of adoption. The former is the relative speed with which farmers adopt an innovation, has as one of its pillars, the element of 'time'. On the other hand, intensity of adoption refers to the level of use of a given technology at any time period (Bonabana-Wabbi 2002).

Feder et al. (1985) posits the adoption of agricultural technologies in two dimensions: aggregate and individual (farm-level) adoption. The aggregate technology adoption was defined as the process of the spread of a new technology within a region whilst individual adoption is defined as the degree of use of a new technology in long-run equilibrium, when the farmer has full information about the new technology and its potential"

Agricultural technologies are transferred to farmers for adoption and in most cases they are carried out on farms with farmers either as trials or demonstrations. Feedbacks from the participating farmers are very crucial to ascertain the impact on their farm practices. It will be meaningless and waste of resources to find that farmers have resorted to their prior methods of production because the new technology is inappropriate to their condition (CIMMYT, 1993). Another way of assessing a technology's acceptability is by following up on what farmers who have hosted experiments do the following year. If a new technology involves purchased inputs, for instance, surveys of input merchants and users may be useful for assessing the spread of the technology (CIMMYT, 1993).

Agricultural technology adoption models are based on farmers' utility or profit-maximizing behaviours (Norris and Batie 1987; Pryanishnikov and Zigova, 2003). The assumption or the notion behind is that farmers will adopt a new technology only when they realise that its benefits outweighs the cost and the perceived utility or profit from using this new technology is significantly greater than the status quo.

The adoption or rejection of an innovation is the consequence of diffusion of an innovation (Raymond, 2001). Diffusion is a process by which new ideas are communicated to the members of a social system (Roger and Shoemakers, 1971). An innovation is an idea, method or object which is regarded as new by an individual, but which is not always the result of recent research (Van den Ban and Hawkins, 1998). Diffusion and adoption are thus closely interrelated even though they are conceptually distinct (Dasgupta, 1989). Not all innovations diffuse at the same rate. The differences in the diffusion rates of innovations in a community can be largely explained by the differences in the traits of innovation, as perceived by potential adopters such as: relative advantage, compatibility, complexity, trial ability and observability (Dasgupta, 1989; Raymond, 2001).

Farmers like scientist over the years have evaluated innovations or technologies before their adoption. They have learnt and experienced that, increases in the rate of adoption of new agricultural technologies, as in this study, agro inputs for soya beans in the world and Africa alike, have increased soya bean productivity, contributed to their farm income, and reduced malnutrition in most cases (Bandeira et al, 2005; Cornejo and McBridgje, 2002). Roggers (2003) reported that farmers do this through a thorough examination of certain characteristics of the innovation or the technology. These include the following:

1. Relative Advantage: It is the degree to which an innovation or technology such as agro inputs is perceived to be better than existing ones which are familiar to adopters. It is positively related to its rate of adoption. For example: a weedicide for wheat crop was earlier used as post emergence weedicide after that pre-emergence weedicide was invented. The use of pre-emergence weedicide was preferred as it did not allow the weeds to grow as compared to the post emergence weedicide, which is used after the germination of weeds which has already incurred some loss to the crop.

2. Compatibility: It is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and the need of potential adopter. The compatibility of an innovation as perceived by members of a social system is positively related to its rate of adoption. Beef production lack compatibility with cultural values in India. Piggery is a profitable enterprise but it is not adopted by Brahmins and Muslims as it is not compatible with their culture.

3. Complexity: It is the degree to which an innovation is perceived as relatively difficult to understand and use. The complexity of an innovation as perceived by members of a social system is negatively related to its rate of adoption. For example, change in variety of a particular crop is flexible as compared to change in total enterprise (e.g. shifting from crop production to poultry production).

4. Trialability: It is the degree to which an innovation may be experimented with on a limited basis. For example, new seeds or fertilizers can be tried on a small scale, but new machinery or a thing like cow dung gas plant cannot be tried. The trialability of an innovation as perceived by a group of people can positively influence its rate of adoption.

5. Observability: It is the degree to which the results of an innovation are visible to others. The observability of an innovation as perceived by members of a social system is positively related to its rate of adoption. For example, the results of some practices like the application of nitrogenous fertilizers to plants are easily observed in the growth and leaves colour of the plants while the results of some innovations like treatments of seeds and soil conservation measures are not easily observed.

On the basis of the above traits it can be said that technologies will be adopted when

1. They are relatively more advantageous than the status quo;
2. They are compatible with social values and past experiences of the adopter, they meet the need of potential adopter;
3. They are simple to understand and use;
4. They can be experimented or tried on a small scale; and
5. When the results are visible, they are rapidly adopted by the members of a social system.

Technologies which are lacking in these traits take more time to be adopted by the members of a social system.

Innovation–Decision Process

The innovation-decision process is the process through which an individual (or other decision making unit) passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision.

2.5 Farmers Adoption and Use Levels of Modern Agro Inputs

Several studies in the past were of the view that smallholder farmers are conservative and adamant in adopting modern farm practices (Toenniessen et al., 2008; Evenson and Gollin 2003). However, the work of Nabwire (2015) revealed that, smallholder farmers demand for knowledge on modern agro inputs especially extension advice on improved seeds, fertilizers and insecticides is very high. He noticed that most of the respondents regularly or occasionally sought extension advice on the agro inputs. Farmers search for further information on agro inputs can be taking as their willingness to adopt them (in the case of this study willingness to pay), which is in accordance with DANIDA (2005), that farmers seeking advice on the inputs can be a manifestation of their willingness and desire to adopt them.

Hellin (2006) reported that being a member of a farmer group has great impact on building their capacity to access agricultural extension advice which influences their interest through collective action and institution. Similarly,Oboh et al. (2011) found that adoption of cassava technology was greatly influenced by group or cooperative membership as they are able to share and assimilate agricultural information. As a group, members meet on regular basis, discuss common problems and share ideas because they understand and trust each other.

To the contrary, Ariga and Jayne (2006) stated that the key issue with modern agro inputs and their impact on agricultural output and productivity is not a matter of their generation and promotion but their adoption and utilization by farmers. Again, Hellin, (2006), found that farmers who belong to farmer groups understand their own constraints and increases their chances of accessing relatively cheap credit, agro inputs and sufficient knowledge and training on their use and are more likely to adopt modern agro inputs.

2.6 Determinants of adoption

The rates at which agro inputs are adopted and used in modern farming differ from one person to another in every socio-economic situation or setting. These differences are determined by a number of factors both at the household level and community level (Smith 2009; Ariga and Jayne 2006). They could be economic, institutional, household specific and technology factors (Mwangi and Kariuki 2015; Lopes, 2010). A clear understanding of these factors is useful in projecting out policy options that can lead to greater access and high adoption of modern agro inputs, thereby resulting in increased agricultural productivity.

The concerns of farmers who actively use modern agro inputs indicate that the appropriateness of any new form of biological and chemical innovation play a significant role in influencing a farmer's decision on whether or not to adopt it. Appropriateness, Nabwire (2015) defined as (1) the expected benefits (output/income) from using the inputs; (2) suitability of the inputs to the local environment (land tenure system); and (3) the sustainability (cost) of using these inputs over a long period of time. Once these favourable socio-economic conditions are met, smallholder farmers will adopt high yielding farm practices as long as they find them appropriate to their agro ecological condition. Okoboi (2011) classified the factors that influence farmer's use of improved inputs as: farmer characteristics, institutional factors and characteristics of the input. Farmer characteristics include sex, age, education status, and household size; while institutional factors include farm size, farmer group membership, access to agro information, access to credit, and access to infrastructure such as roads or storage. Characteristics of the production input relate to the subjective attributes of the input as perceived by the farmer

Several studies, (DANIDA 2005 and GOU, 2004), have also shown that finance is a major challenge in the adoption of productivity enhancing technologies by smallholder farmers, due to limited access to credit. Smallholder farmers thus rely on poor quality and low yielding agro inputs mostly obtained from informal input delivery sector. Mwongoso (2015) identified the challenges of soya bean farmers as unavailability of good quality inputs, type of land tenure, poor transport links and poor agronomic practices. Therefore, any agricultural technology with accessible credit market for smallholder farmers to purchase their complementary or associated agro inputs will have a higher rate of adoption. Extension and well- targeted rural microfinance may increase rates of technological uptake and use among resource challenged producers.

Distance to the nearest agro input market or dealer and poor road network increases transaction and transport cost of acquiring the inputs for farming. Olwande and Mathenge (2010), assert that long distances may increase transport and transaction costs in acquiring inputs and can thus limit their use (Olwande and Mathenge 2010; Ariga and Jayne 2006). It is commonly perceived that private traders and input suppliers tend to locate and confine their businesses close to towns and market hubs where infrastructure is relatively well developed (Olwande and Mathenge 2010). Therefore farmers living in more rural areas are largely cut off from input markets and extension services, which ultimately affect both technology adoption and farm productivity negatively.

According to Foster and Rozenweig (2010) a key factor that determines technology adoption is the cost of the technology. The cost being explained economically as the price of the product, the higher the price, the lower the quantity that may be bought and other way round. Oti-Agyekum, (2014) reported that when farmers are buying agro inputs, they are influenced by the product price, their packaging and branding. They prefer moderate price, well packaged for ease of handling and labeled to facilitate the product application. The removal of subsidy on seeds and fertilizers by the World Bank during the structural adjustment programme in the sub-Sahara Africa widened the constraint of using these inputs (Muzari, 2013; Banful, 2009).

Another determinant with positive impact on technology adoption is off farm income. This is because off-farm income acts as an important strategy for overcoming credit constraints faced by the rural households in many developing countries (Reardon et al., 2007). It acts as a substitute for borrowed capital in rural economies where credit markets are either missing or dysfunctional (Ellis and Freeman, 2004; Diiro, 2013). According to Diiro (2013) off- farm income in a way provides farmers with liquid capital for purchasing agro inputs such as improved seed, inoculant, fertilizers and weedicides in the case of soya bean production. He identified a higher adoption rate and expenditure on purchased inputs among households with off-farm income than those without. Inability of farmers to generate extra income from off-farm activities can subject them to subsistence production (Aliber and Harts, 2010).

Contrary, Goodwin and Mishra (2004) expressed that the search for off farm income can reduce the adoption of technology by transferring labour from agricultural sector to other sectors causing labour shortage.

According to Adegbola and Gardebroek (2007), educated farmers are able to better process information, allocate inputs more efficiently, and more accurately assess the profitability of new technologies, compared to farmers with no education. Zavale et al. (2005) and Uaiene et al. (2009) report that the level of education attained by households in Mozambique is positively associated with households' adoption behaviours. They suggested that education positively influences households in their realisation of low agricultural productivity which enhances their adoption of new agricultural technologies that increase their productivity, household income and standard of living. However they also report that most household heads in Mozambique are illiterate and had attended school for only a few years.

According to Feder et al. (1985), some new agricultural technologies, including improved varieties, are more labour intensive, compared to traditional varieties. Thus, labour shortage may prevent farmers from adopting new agricultural technology. The authors argue that a household with a large number of family members who are available to work on the farm are more likely to adopt new technologies than households with a small number of family members

Institutional factors (such as access to extension services, credit, roads, price information from markets, and membership of an agricultural association) have been widely used to assess farmers' adoption behaviour. Pattanayak et al. (2003) argue that access to extension services provided by the government, NGOs, and other stakeholders play an important role in technology adoption.

2.7 The Concept of Willingness to Pay

Willingness to pay (WTP) examines or investigates the maximum amount of money a person is willing to pay in order to obtain a certain good or service.The willingness to pay is "the maximum amount of money that a person would be willing to offer in return for receiving a benefit" (Mburu, 2005). It reflects the amount of the benefit or utility that the goods or services give to a person. Theoretical basis of WTP is equivalent to the Compensating Variation (CV) measure. The CV is a measure of how much a consumers' income needs to increase or decrease in order to keep utility constant in the case of a price change of goods, a change in product quality or if new products are introduced (Lenksjo andNordzell, 2014). This can also be interpreted as the benefit received from purchasing the goods to the benefit given up in money, and thereby keeping the benefit at equilibrium. The respondents´ stated utility is based on his or her preferences and can therefore be expected to differ between individuals.

Baidoo et al., (2013) reported that, this can be done even before production and supply or during marketing period. Valuation of, for example, agro i`nputs is done so that input prices are introduced to its users. There are many ways of doing this, but it is economically prudent for the economic agents to be allowed to value the goods at stake. Estimation of the value of agro inputs provides evidence on the farmers' ability to pay in introducing such products or inputs (Young and Gray, 1996). This may lead to a valid and reliable estimation of an individual's strength of preference for the proposed commodity as in the case of agro inputs for soya.

2.8 Contingent Valuation Method

The study adopted Contingent Valuation Method (CVM) because it is more adaptable for measuring the value of goods by creating a hypothetical market situation and does not impose restrictive assumptions on an individual's preference. CV allows a direct estimation of WTP by means of direct elicitation technique. Consumers show their WTP for a hypothetical product without actually paying for it.

There exist many methods used to understand consumer choices in a particular market situation. One of such methods is Revealed Preference Methods which depicts real consumer choices in the market scene. Young (2005) cited two of them as, contingent valuation method (CVM) and Contingent Choice Method (CCM).

CVM directly asks the respondents for their WTP or WTA (Willingness to Accept) for a clearly defined good or services. In an assumed market condition, the interviewees are asked how much they would be willing to pay for the good/services or whether they would agree to make payment of an offered or suggested amount or bid amount for the good/services. Since the respondents are able to show their preference on the hypothetical market, the method is useful when there is no real market or actual consumer expenditure to utilize for the valuation. The hypothetical market must be as close as possible to a real market, and therefore, pictures, photos and so much more can be provided to enhance description of the goods/services (Mburu, 2005).

In order to obtain the respondents' WTP by CVM, different types of elicitation formats have been used. Those included the open-ended question, bidding game, payment card, and the dichotomous choice approach.

The early studies of CVM tended to have the open-ended question format, which simply asked the respondents to state how much they would be willing to pay for the goods or services. However, this format experienced many problems, such as high rates of non-responses and unreasonably high or low valuations (Young, 2005).

In the payment card format, a range of potential bid amounts was prepared and the respondents were asked to choose the value that was the closest from their WTP. This approach had still experienced the starting bias although the bias was found to be not as strong as they were in bidding game (Young, 2005). In the bidding game format, a respondent was asked if he or she would be willing to pay a specific bid amount of money for the goods/services. If the respondent answered yes", he or she was asked the same question for an increased bid amount, and increased bid amounts were continued to be asked until the respondent says no. Similarly, if the answer to the initial bid amount was “no”, decreased bid amounts were continued to be asked until the respondent say yes. A problem with this format was that the estimated WTP tended to have correlation with the initial value, which was called starting point bias (Cummings et al., 1986).

The dichotomous choice approach, that included single-bounded and the multiple bounded choices, was developed to overcome the limitations of the elicitation formats that were used at the early stages of CVM studies (Young, 2005). In the single-bounded dichotomous choice approach, a randomly selected single amount of bid was offered to a respondent and the respondent provided an answer of “yes” or “no”. The “yes” or “no” answers from the respondents were converted to a variable and WTP is estimated from the statistical models based on the probability of “yes” or “no”, the bid amount, and other socio-economic variables. The approach was thought to have less bias because it was simple enough that respondents had no incentive to strategically bias answers toward the desired outcome (Young, 2005).

2.9 Studies on Willingness to Pay

Onoh et al., (2014) on the analysis of livestock farmers’ willingness to pay for agricultural extension services in south east Nigeria discovered that 35.3% of the farmers were willing to pay, while67.7% were not willing to pay for extension services. They observed that, in home stead fish production, improved poultry production and animal feed production farmers were willing to pay. However, farmers were not willing to pay for most of the other extension services; such as, improved techniques in sheep and goat production and improved technique in rabbit production. They attributed these to such reasons as ability to handle the technologies easily, or that the traditional extension service of government freely provided them with enough information to take care of such needs or problems arising from them, or still they may find such technologies inappropriate. Better still, they also identified that farmers were more willing to pay for services that were technologically complicated to handle themselves or those that have high profit margins compared to what is in use now when they adopt.

They employed multi stage random sampling procedure to select a sample of 396 respondents for the study. Data was collected using a se4mi structured questionnaire. A 4- point likert rating scale was adoptedin terms of: Strongly unwilling = 1; Unwilling = 2;Willing= 3; andStrongly willing = 4.

For the study on theextent of extension services currently paid for by farmers, the scores assigned to the categories were as follows: Very great extent = 4; Great extent = 3; Low extent = 2; and Not at all = 1.

For perceived benefits for paying for extension services, the scores assigned to the categories were as follows: Strongly agree = 4; Agree = 3; Disagree = 2, and Strongly disagree = 1

Aidoo et al., (2013) in their assessment of factors influencing soya bean production and farmers' willingness to pay for inoculum (rhizobium inoculant) use in northern Ghana, found that 80 % respondents were willing to pay for inoculums when displayed in agro-inputs shops. Their findings identified factors such as experience in soya bean production, access to credit, market surplus and awareness about inoculants as factors influencing farmers' willingness to pay for inoculants at 5% significant level. They also noted that, male farmers were more willing to pay for inoculants than their female counterparts due to the distance travelled to input markets which are enhance by men's ownership of assets such as bicycles and motorbikes in the area and distance from home to farm was found to be inversely related to farmers' willingness to pay for inoculants application.

They used a sample size of 240 grain legume farmers of which 188 were soya bean producers as well. The study covered four selected districts and six communities which were stratified into N2Africa project area and Non N2Africa project area, where simple random sampling will be used. Data analysis was done using descriptive statistics, ordinary least square for the Cobb Douglas Production function of soya bean production.

Oti-Agyekum, (2014) investigating farmers' willingness to pay for faecal compost in southern Ghana observed that farmers were willing to pay only if faecal compost price was low, well packaged and have labels showing nutrient content and application instructions as it is in the case of chemical fertilizers. Factors influencing respondent's willingness to pay for faecal compost included household size, income, age and education level.

On farmers understanding of faecal compost and other organic fertilizers, it was discovered that, 99.50% were aware of cow dung, 42.50% of them had used faecal compost or organic fertilizer before and 32.0% were currently using it for crop production. For the respondents' knowledge on faecal compost, 32% heard of it as organic fertilizer, 6.20 % of them had used it on their farm before and only 1.0% of the people were still using it. Moreover, media was found as the main source information on faecal compost which substantiates observation made by Keraita et al. (2010); Obuobieet al., (2006) and Boholm (1998) that the media is the main source of knowledge in the use of waste by farmers. Therefore, when introducing any new product to rural people especially farmers, media will be more convincing channel to adopt.

Ahuja and Sen (2006) studied willingness to pay for veterinary services from poor areas in rural India using payment card and discovered that respondents agreed to buy cards at the offered prices. The yellow cards represented in-centre service and blue for home service. About 80% of those offered yellow cards at Rs 100 and Rs 200 (Rupees) agreed to purchase it. But the proportion declined to 12% for yellow card and 19% for blue cards in the case of highest bid price. The reasons that accounted for their decline were that they could not afford or the amount they were willing to pay was lower than the bid price on the payment cards. Moreover, a very small percentage questioned the credibility of the scenario. There is therefore a high level of credence in eliciting willingness to pay using contingent valuation method. The authors observed that on average, households were willing to pay or spend approximately 300Rs-325Rs for in-centre service and Rs.570-600 for home service? They discovered that the amount of money respondents wanted to pay varied across income groups and household specific characteristics. They found that willingness to pay for the service is negatively determined by price and statistically significant meeting their a-priori expectation. Other determinants identified were income measured by wealth index, educational level, number of bullocks owned in the case of service centres, and number of buffaloes and crossbred owned in case of home service.

Abebe and Bogale (2014), in their study on Willingness to pay for Rainfall based Insurance by Smallholder Farmers in the Dugda and MiesoWoredas in the Central Rift Valley of Ethiopa found that most of the respondents (89.4%) were willing to pay for whereas 17.6% were not willing to pay for the crop based insurance. They identified that 97.9% of the willing respondents were males while 2.1% were females. Of non-willing respondents, 82.4% were males and 17.6% were females. They also observed that sex of household heads between willing and non-willing categories were statistically significant.

Also, findings revealed factors to be influencing respondents' willingness to pay for rainfall based insurance; age of respondent, total income from farm, total off-farm income, livestock holding, owning radio and availability of public and private aid.

Similarly, Abdulla et al. (2014), in a study on farmers' willingness to pay for crop insurance in North West Selangor Integrated Agricultural Development Area in Malaysia (IADA). They found the mean age of respondents to be 48 years with more than 90% males and less than 5% females as most of the field work was done by men. They also found that 87% of the respondents were married with a mean dependent rate of 5 children and maximum of 11. The ethnic groups of the respondents consisted of 93% Malay, 5.6% Chinese and 0.7% Indian. About 3.1% of the respondents had never been to school, majority (57%) attained secondary education; 35.5% attended primary school while 5.9% reached tertiary level indicates that majority of the respondents were educated. They observed that, averagely each respondent had 6.22 hectares of the total land area. The average years of experience in paddy production was 21 years and maximum of 63 years. Gross revenue per yield value of RM1106.65 to RM 69631.00 per season and the mean number of times a respondent attended a training course with respect to paddy production was minimum of one and maximum of 8 times. They found that age, number of times respondent attend production course, total farm size as well as years of experience in paddy production were statistically significant, but only age had a negative coefficient.

This has inverse relation on willingness to pay, meaning that, the older the paddy farmer, the lower their willingness to pay for the insurance scheme.

Biamah (2013), studied processors willingness to pay for product quality certification in the infant cereal food sector in Greater Accra Region in which 68.6 % of the respondents studied were females and 31.4% were males with a mean age of 42 years, minimum of 21 years and maximum of 63 years. Ninety three per cent (93%) of the respondents were married, 3% were singles 2% were separated or divorced and 2% were widows. She noticed that most (42.9 %) had tertiary education, 25.7 % had secondary education, 14.3% had primary, and 17.1% had technical education. The mean age of firms or business was 5 years, while 13years and 6 months were maximum and minimum respectively. She also found that 77% of the businesses were sole proprietors while 23% were partnership and limited liability companies. On the scale of production, she observed that 48.6% were small (6-29 employees) and 51.4% micro (0-5 workers). Most of the employees of the subsector were women (68.6%) and 98% of the firms were using family labour for various activities of which 93% have permanent employees. She discovered that, 60% of the respondents were not willing to pay for product certification but 40% were willing to pay at the bid price for product certification. The educational level, number of years of establishment, annual income and access to loans were statistically significant factors influencing willingness to pay for product certification.

The methodology she adopted for this study involved, snow ball sampling technique and the use ofstructured questionnaire in a face to face interview for data collection. The author used a sample size of 35 for her study. The models for data analysis were logistic regression and tobit.

Mathematically express as follows:

Pi=1/ (1+e (-z))

Where Z is an underlining stimulus index, which is a random variable that impacts on the probability of willingness to pay for any respondent and is the observation on variables for the willingness to pay model.

If Pi is the probability of willingness to pay for product quality certification (PQC), then the probability of unwillingness to pay is 1-Pi which can be expressed as

1-Pi=1-1/ (1+e (-z))

This study adopts single bound dichotomous choice approach of elicitation in the contingent valuation method to elicit farmers WTP because of prevailing existing market price for the agro inputs in question and it also eliminates starting point bias (Jayson and Hudson, 2004; Sattler and Volckner, 2002). The study first estimates a logit regression following after Xie et al. (2011); Adeogun et al. (2008) and Hagos et al. (2012) and a tobit regression following after Chase et al., (2009); Hagos et al., (2012) and Qualls et al., (2011) with level of maximum WTP as dependent variable. The independent variables used in the logit and tobit models of this study are age, household size, farmer's years of experience in soya bean production, participation in soya bean demonstration and gains made, distance to the nearest agro input market, access to credit, farmer group membership and access to agricultural extension.

2.10 The Concept of Cost, Revenue and Profit

According to the theory of cost, the cost of producing a commodity is depended on the price and quantities of inputs used in the production process. Cost of production is the average cost of producing one unit of commodity (Adegeye and Dittoh, 1985). Therefore the total cost is the sum of all the cost; both fixed and variable spent on producing a commodity. Mathematically, it is expressed as;

Total Cost (TC) = Total Fixed Cost (TFC) + Total Variable Cost (TVC)

The Total Revenue (TR) is multiplication of output/product by price. The profit (π) is the Total Revenue (TR) minus the Total cost (TC). Mathematically profit can be expressed as;

Profit (π) = Total Revenue (TR) – Total Cost (TC)

According to Adegeye and Dittoh 1985, Benefit-Cost Ratio (BCR) also called the profitability index, is a ratio of the net present value of future net cash flow (discounted benefits) over the life of project or business to the net investment (discounted cost). Gittinger, (1982) explained benefit –cost ratio (BCR) as the ratio of the present net worth of the benefit stream to the present net worth of the cost stream. World Book encyclopaedia also explained benefit B/C as a ratio that measures the benefit and cost to society of the existing or proposed programmes.

Mathematically Benefit – Cost Ratio (BCR) is given as;

$$BCR = \frac{[\sum B_i/(C_i + d)^i]}{[\sum C_i/(C_i + d)^i]}$$

Where

B_i =Benefit in each year

C_i=the cost in years

i = number of years

d = interest (discount) rates

2.10.1 The Decision Criterion for the Benefit –Cost Ratio

After benefit cost analysis, one has to decide whether to pursue the project in question or not. The rule of thumb is that, production is profitable when the ratio is greater than one (1), while a ratio less than one is not profitable.

A benefit –cost ratio of one (1) indicates a break-even point (Gittinger, 1982).

Contribution is the value available to paying overheads and profit, and it is given as: selling price per unit –variable cost per unit.

The percentage of the selling price that is left after paying variable cost per unit is known as the contribution margin percentage.

2.10.2 Uses of Benefit-Cost Ratio

Benefit cost ratio is normally done on discounted benefit to discounted revenue. Therefore, a project should be undertaken if the ratio is greater than one, a ratio of exactly one means the project just break-even; thus it is neither making profit nor loss. But a ratio of less than one means that the project should be discarded or abandoned. This means that the BCR indicates whether a project is worth undertaking or not.

World Book encyclopaedia also explained B/C as a ratio that measures the benefit and cost to society of the existing or proposed programmes.

Aside enumerated some of the uses of B/C ratio in analysis as:

• Helps society, industries and government to make decision

• In addition, the uses of benefit – cost ratio help focus on the clearly stated proposal such as plans to expand the business. They try to determine the effects of the proposal on as large, a number of people as possible.

• In using the benefit – cost ratio in analysis, it assesses that if the program produces economic benefits that exceed the cost of putting it into action, the program is judged to be worthwhile. Such projects as described by world book encyclopedia are cost effective.

• Due to the problems of studying policies that affect people for many years, a delay in receiving something generally lowers its current value. Analysis calculates this lower value through a procedure called discounting. Analysis often calculates this ratio between the discounted value of benefits and the discount value of costs. If the ratio is greater than one, the project is considered economically worthwhile.

2.11 Farmers Challenges in Soya Bean Production

The significant contribution of the agricultural sector in terms of employment and gross domestic product (GDP) over the years is well acknowledged while less than 1 per cent of commercial lending in Africa goes to agriculture (World Bank, 2012). Meanwhile, the larger share of the loans to the sector go to large scale commercial farmers, unfortunately smallholder farmers are mostly disadvantaged.

The main reason for the lack of interest of commercial banks to lend to agriculture is the risky nature of this activity, due to the constraints discussed in this study and amplified by fluctuating commodity prices and government inefficiencies. At the same time, microfinance institutions charge high interest rate – at times up to 100per cent interest on trading activities and urban areas, resulting in insignificant allocation of credit to smallholder farmers.

New technologies are required to raise the output of farmers' crops in the presence of changing climate and variability. Farmers may adopt technology or an input, only with expectation that it will increase their output. Soya bean farmers like others, encounter many challenges in the course of production process. Many studies (Doss, 1999; Farrow, 2014) have discovered several of these challenges. Doss (1999) noted that access to labour, agro inputs and farm lands; among others were the common challenges faced by farmers especially women farmers. For instance, during the cropping season, household labour is allocated to different enterprises where hired labour may not be available or too expensive.Household size and composition, migration, health of household members influence the supply of agricultural labour.

Farrow (2014), in reviewing constraints to adoption legume technologies identified the following; access to land, capital, availability of labour, literacy of household members, access to seeds, market for output or products. In other studies, problems confronting farmers were found to include access to credit, agro inputs, output market (Etwire et al., 2013;Al-Hassan et al., 2006). Berchie et al. (2010) also revealed unreliable weather like condition of erratic rainfall and high temperatures coupled with unavailable farm labour at the peak of the farming season which can be attributed to youth migration to urban parts of the country. In another development, Ugwu and Ugwu, 2010, stated pests and diseases as challenges to soya bean production in Nigeria.

Dogbe et al., (2013) identified many challenges hindering soya bean production in Saboba and Chereponi Districts of Northern Region in Ghana. Some of them were limited access to land, bad weather, poor access to agro inputs, and soil infertility. Others were price instability for farm produce, inadequate labour, poor storage facilities and pest and diseases.

2.12 Agro Inputs Sold by Dealers in Ghana

In the recent past, Ghana's agricultural development was solely a prerogative of the government. From research and development, extension delivery, to agro inputs supply; all were controlled by the state. There has been a marked change in the system today. One of such key areas is the agro inputs market where seeds, fertilizers, crop protection chemicals such as pesticides, herbicides and fungicides are being distributed by private individuals and organisations (Tripp and Gisselquist, 1996).

The rising population growth rate and the pressure on agricultural land has led to the intensification of cropping systems, and increased the utilization of agro inputs in farming. Crop diversification and technical change have also contributed to a wider demand for agricultural inputs. Government has cut subsidies and has largely stopped distributing of agro inputs especially fertilizers through extension and credit programmes until 2008 when global food crisis hit the country and some fertilizers were subsidized.

Government participation in the provision of inputs has been shifted to a regulatory role that registers and controls the inputs that are available (whether imported or produced domestically) and ensure the quality of those products once they are on the market.

Krausova andBanful (undated) found 3389 agro dealers contrary to the FAO (2005) that there were 700 agro dealers across the nation. They discovered that inputs such as fertilizers, crop protection chemicals, agricultural tools, seeds and animal feeds were the main inputs sold in Ghana by agro dealers. The number of input sellers varies from region to region with the highest concentration of 761 dealers in the Ashanti region Krausova and (BranoahBanful undated). The region also served as the hub of input distribution once they are evacuated from the port at Tema.

Krausova and BranoahBanful (undated) also observed that 84 % of input dealers were selling fertilizers in 2009 in Ghana with 91 % crop protection chemicals and 61 % improved seeds to farmers. Northern region was the lowest selling region with 66 % of dealers reporting fertilizer sales and Upper East is the highest selling region with 99 % of dealers reporting selling fertilizers. Among fertilizers were sulphate of ammonia, NPK and urea.

Another form of inputs distribution is the stockists who make their ware more convenient to meet the pockets of small scale farmers through repackaging. They normally package agro-inputs such as fertilizers, seeds and agro-chemicals like fungicides and insecticides at their retail shops for sale. This stimulates the application of some inputs but not at recommended rates of the agro-inputs to accrue the full benefit of their utilization. Apart from the fact that repackaging of inputs by stockists makes it affordable to farmers, it subjects the handlers to the risk of chemical poisoning at the detriment of their health.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter presents the methodology employed for the study. It discussed the study area, scope of the study, the theoretical framework, empirical models as well as methods and concept adopted for the study. The chapter also provides information on the sources of data and techniques employed in gathering data for the study. The section on sampling and sample size describes the procedure of selecting respondents for the study.

3.1 The Study Area

The study was conducted in the three Northern regions of Ghana namely Northern, Upper East and Upper West regions. The regions were selected based on their major contribution to soya production in the country and presence of N2Africa. These regions share boundaries with the Republic of Burkina Faso to the north, Togo to the east, and La Cote d'voire to the west and with other three regions BrongAhafo, Greater Accra and the Volta regions to the south of the country.

Northern Region is the largest among the three regions in terms of land mass and population followed by Upper West and Upper East with an area of about 70,380, 18,480 and 8,840 square kilometres respectively.The study area has a total sum of population of 4,177,763 million people (PHC, 2010). Northern region has population of about 2,468,557, Upper East 1,031,478 and Upper West 677,763 (MoFA, 2010).

The climate of the region is relatively dry, with a single rainy season that begins in May and ends in October. The amount of rainfall recorded annually varies between 750 mm and 1050 mm. The dry season starts in November and ends in April with maximum temperatures occurring towards the end of the dry season (March-April) and minimum temperatures in December and January. The harmattan winds, which occur during the months of December to early February, have considerable effect on the temperatures in the region, which may vary between 14°C at night and 40°C during the day. Humidity, however, which is very low, mitigates the effect of the daytime heat.

The main vegetation is classified as vast areas of grassland, interspersed with the guinea savannah woodland, characterised by drought-resistant trees such as the acacia, baobab, shea nut, dawadawa, mango and neem. Guinea savannah woodland, which is suitable for rearing different types of animals, such as cattle, sheep, goats, pigs, guinea fowl, and other poultry, all of which are raised to complement income generated from crop production. The major crops grown by farmers in northern Ghana are grains and cereals, such as maize, rice, millet, sorghum; legumessuch asSoya bean, cowpea, groundnut, Bambara beans, pigeon pea; vegetables such as tomatoes, garden eggs, pepper, onion, cabbage, carrot, okro and roots and tubers such as yams, sweet potatoes and cassava. The soils in the study regions are classified as Savanna Ochrosol and Groundwater Laterites in the interim Ghana soil classification system (Adjei-Gyapong and Asiamah, 2002) and as Plinthosols in the World Reference Base for soil resources (WRB, 2015). These soils which are shallow with poor water percolation were formed under the influence of ground water and lateral water flows from adjacent uplands. They are wet soils with iron accumulations that irreversibly harden upon repeated drying and wetting to form iron concretions and iron pans.

3.2 Population and Sample size

The target population for the study consisted of all soya bean producers in northern Ghana.

Following Godden (2004), the sample size was determined by using the formula

$$SS = \frac{Z^2 \times (p) \times (1-p)}{C^2}$$

Where: SS = Sample size, Z is Z-value (confidence level). This study adopted 95 per cent confidence which is 1.96, P = Percentage of population picking a choice, expressed as decimal and C = Confidence interval, expressed as decimal

$$SS = \frac{1.96^2 \times (.5) \times (1-.5)}{0.05^2}$$

SS = 384

The sample size was approximated to the nearest hundreds of four hundred (400) to obtain a sample size that was easy for calculations and analysis on the study population

3.3 Sampling Procedure

Multi stage sampling procedure was used for the study. In stageone the study area was first stratified into three regions namely Northern region, Upper East and Upper West regions.Stage two involved purposive sampling of eight (8) districts among others known for soya bean production in consultation with N2Africa (Putting Nitrogen fixation to work for smallholder farmers in Africa) project, Ministry of Food and Agriculture and ADVANCE project who are key stakeholders in the promotion of soya bean production in northern Ghana. Four districts were selected from Northern region and two each in Upper East and Upper regions. The four districts in the northern region areSavelugu,Saboba, East Gonja and Yendi Municipality.

The two districts selected in Upper East region were Bawku West and KassenaNankenawhile Nadowliand Sisala West districts selected in the Upper West region.

In stage three random sampling was used to select soya production communities in the prior mentioned districts. In the Northern region, five (5) soya beans producing communities were selected from each of the four districts totaling twenty communities. In the Upper East Region, five communities were selected from each district while in the Upper West Region four communities were selected from each district.

In the fourth stage, ten (10) soya bean farmers were then drawn randomly from each community in a district and interviewed in Northern region. In the Upper East Region, twelve farmers were randomly selected from each community while in the Upper West region ten farmers were randomly selected from each community. Of the 120 and 80 questionnaires issued in Upper East and Upper West regions, 112 and 76 were respectively retrieved. As a result the researcher decided to add remaining twelve (12) to the 200 sample from Northern region because of the higher level of soya bean production in the region (Table 1)

Table 1: Sampling Procedure

Regions	**Northern**	**Upper East**	**Upper West**
Districts/Region	4	2	2
Communities/District	5	5	4
Respondents/community	10	12	10
Total sample/Region	200	120	80
Questionnaires Received/Region	200 + 12 = **212**	**112**	**76**

3.4 Types of Data for the Study

The study largely depended on primary data sourced from the sample respondents.Primary data were collected from sample respondents, focused group discussants and key informants. The diverse sources were aimed at validating the responses obtained through the personal interviews on perspectives of farmers in agro inputs for soya bean. Secondary data were also obtained on population as well as economic activities, vegetation, rainfall, crop yields with more focus on soya bean. The secondary data sources include official documents from Districts, Municipal Assemblies, Meteorological service department, and Ministry of Food and Agriculture.

3.5 Data Collection Technique and Instruments

The data collection technique employed for the study involved questionnaire interview, focus group discussions and key informant interviews. Triangulating the data collection or using more than one method was used to give a better understanding of the research problem by providing detailed information on the subject of study (Creswell et al. 2007).Before using the survey instruments, both questionnaire for individual interviews and checklist for focus group discussions were pre-tested in non-sampled respondents with similar characteristics. The information generated during pre-testing was incorporated into the questionnaire and checklists with necessary modifications before implementation of data collection. The focus group discussions were carried out in addition to the personal interviews to gather general information from producers of soya beans on inputs, benefits and cost in soya bean production.Focus groups discussion are instruments used to learn about why and how a particular group of people approach an issue and they can be used to evaluate a programme or policy or to understand product marketing in the case of farmer's willingness to pay for agro inputs.

Enumerators who understand the local languages were recruited from each study area and trained on interviewing techniques. Semi structured questionnaires and interview guides were the instruments used to gather data for the study.

3.6 Method of Data Analysis

Data was analysed using both descriptive statistics (qualitative) and econometric (quantitative) models. Descriptive statistics was employed to evaluate mean, percentage, standard deviation and frequency. In the econometric approach,Kendall's Coefficient of Concordance, and gross margin analysis Tobit and Logit models were also used.

3.6.1: Tobit Model

In this study the Tobit model was used for analysing the factors that will influence WTP and the maximum amount of money each respondent would be willing to pay. Meseret (2014) reported that the model has advantage over other discrete models (LPM, logistic, and probit) on the account that, it revealed both the probability of WTP and the maximum respondents are WTP.

Folowing Long (1997), the structural equation of the Tobit model can be expressed as:

$Y_i^* = X_i\beta_i + \varepsilon_i$……………………………………………………………………(1)

$$Y_i = Y_i^* if\ Y_I^* > 0$$

$Y_i = 0\ if\ Y_I^* \leq 0$

Where;

Y_i = Observed dependent variable (maximum WTP)

Latent variable (not observable)

X_i =Vector of factor affecting WTP

β_i =Vector of unknown parameters to be estimated

ε_i = Residuals that are independently and normally distributed with mean zero and constant varianceδ^2

The model parameters can be estimated by maximizing the tobit likelihood function of the following form (Maddala, 1997);

$$L = \prod_{Y_i^*>0} \frac{1}{\delta} f\left(\frac{Y_i - \beta_1 X_1}{\delta}\right) \prod_{Y_i \leq 0} F\left(\frac{-\beta_1 X_1}{\delta}\right) \ldots\ldots 2$$

Where f and F are density function and cumulative distribution function respectively.

$Y_i^* \prod Y_i^* > 0$, means the product over those $i$for which$Y_i^* > 0$, and $\prod Y_i^* > 0$, means the product over those i for which $Y_i^* < 0$. Maddala (1997) proposed the following techniques to decompose the effects of explanatory variables into the decision to pay and intensity effects. Thus, a change in X (explanatory variables) has two effects. It affects the conditional mean of Yi in the positive part of the distribution, and it affects the probability that the observation will fall in that part of the distribution. Similar approach will be used in this study.

The marginal effect of an explanatory variable on the expected value of the dependent variable is:

$$\partial E(Y_i / \partial X_i = F(z)\beta_1 \ldots\ldots 3$$

Where; $\beta_1 X_1 / \delta$ is denoted by z, and F is cumulative distribution

The change in the probability of willingness to pay as independent variable Xi changes is:

$$\partial F(z)/_{\partial X_1} = f(z)^{\beta}/_{\delta} \ldots\ldots 4$$

The changes in the amount of money respondent are WTP with respect to a unit change in an explanatory variable among those who are willingness to pay are:

$$\partial E(\frac{Y_i}{Y_i^*} > 0)/\partial X_1 = \beta_1[1 - Z\frac{f(z)}{F(z)} -$$

$$\left(\frac{f(z)}{F(z)}\right)2] \ldots\ldots 5$$

Where;

F (z) = is the cumulative normal distribution of z,

f (z) = is the value of the derivative of the normal curve at a given point (unit normal density),

z = is the z score for the area under normal curve,

δ = is the standard error of the error term.

3.6.2 Logit Model

Since the logit model of single bounded dichotomous format, individual farmers are given initial bid value in which they may accept or reject. In the logit model the dependent variable is dummy variable yes/no. The purpose of the Logit model is to estimate the mean WTP. Following Gujarati (1999), the Logit model is expressed as follows:

$$(P(x)) = \beta_o + \beta_i Xi + \varepsilon_i \ldots\ldots (6)$$

Where; $(P(x)$ isprobability that a given farmer is WTP, $\beta_\circ$ is constant term, β_i is the regression coefficient to be estimated or logit parameter, Xi is the initial bid value and $\varepsilon_i$represents the error term.

One of the main objectives of estimating an empirical WTP model based on the CVM survey responses is to drive a central value or mean of the WTP distribution Hanemann et al (1991).

And the mean willingness is given as:

$$\mathrm{E}E(WTP = \frac{in(1+\exp(\beta_o))}{\beta_i} \quad \ldots\ldots(7)$$

Where; β_i is bid coefficient, β_o is constant term.

3.7 Gross Margin

The profitability of soya bean production was analysed using the Gross-margin analysis

Profit maximization, a motivating factor for crop production, is a key among the important goals of farm enterprises. An estimate of the profitability of every farm enterprise is always based on cost-return analysis. The cost and returns involved in the production are listed and using them to arrive at such estimates as the return to one unit of resources used the gross margin as well as the net farm income.

BiamC. K. and TsueP. T.,(2013)reported that gross margin is the preferred method of determining the profitability of subsistence farm enterprises in which fixed capital is negligible. In Northern Ghana, most of the soya beans are being produced by smallholders this justifies the use of gross margin to determine profitability of soya

Profit generally is the difference between the total revenue and total costs (Olukosi and Ogungbile, 1989).

This study, therefore, examines the costs and returns in soya bean production in the Northern Ghana. It is hypothesized that gross margin is profitable in the study area. The outcome of the study is expected to guide the implementers and promoters of soya bean productionin policy direction to ensure continued and increased production of soyabean.

Gross Margin = Total Revenue – Total Variable Cost

Where, Total Revenue (TR)

TR= P Q

P is Price of soya bean, Q is Output or quantity of soya bean produced and TR is Total Revenue.

Total Variable Cost includes cost of labour, seeds, weeding, ploughing, transportation and others.

It is calculated by multiplying the total yield or output of soya bean by price per bag (100kg) equivalent. The price and yields for soya bean in the study area were obtained from the local markets and soya bean farmers during the focus group discussion.The cost of inputs and production costs were obtained directly from farmers. Production costs identified in this study includes land preparation charges (ploughing), seed cost, herbicides, planting/sowing, weeding, harvesting, threshing and transporting costs. It should be noted that costs was done per acre.

3.7.1 Strength and Limitations of the Gross Margin Technique

Ntibiyoboka (2014) outlined the use of Gross Margin analysis which presents some strong points.

It is easy, simple and flexible to use. This implies that it is easy to calculate thus, it involes multiplication, addition and subtraction which are within the understanding of most farmers.

It is simple to use and good for making comparison of returns to resources for different enterprises and it suggests relative efficiency in different markets.

Additionally, Gross Margin cannot be assumed as a profit figure or amount because fixed costs have to be covered by Gross Margin in order to derive the net profit figure.

Gross margin like any analytical tool has limitations and some may include;

Difficulty in the allocation of labour: this is so because in most businesses or ventures there are permanent labour and casual labour. But what happens to gross margin analysis is that attention is placed on the casual labour associated with that particular activity such as sowing, weeding, harvesting, processing and packaging.

Risk in decision making: Agricultural production is full of risk and uncertainty, such as unstable pricing in markets, crop failure and variable input costs. If a gross margin analysis showed that there was a single crop that was far more valuable than others, this does not mean that it is the best decision to plant only that particular crop rather an assessment needs to be made so that the risks can be managed.

Gross margins do not take into account overhead costs: A gross margin analysis may show a good result for one particular crop; however after all the overhead costs are included such as in a 'cash flow budget' or a 'profit and loss budget' the business may still make profit in Ghana

It should be noted that total cost of production takes into account both variable and fixed costs. If price (**P)** is greater than zero, then soya bean production is said to be profitable and vice versa. A value of zero is an indication of break even. The analysis will be based on an acre of land through scalar transformation of all individual observations.

3.8 The Theoretical Concept of Kendall's Coefficient of Concordance (W)

The Kendall's Coefficient of Concordance (*W*) analysis as a statistical procedure was used to rank the farmers perceptions of the challenges in soya bean production from the most important to the least important, and then measures the degree of agreement/concordance between the respondents. The formula for the coefficient of concordance (*W*) is given as:

$$W = \frac{n[\Sigma T^2 - (\Sigma T)^2/n]}{nm^2(n^2-1)} \text{ Or } nT/nm^2(n^2-1) \ldots\ldots (1)$$

Where; W is the index that measures the ratio of the observed variance of the sum of ranks and the maximum possible variance of the sum of ranks. T is the sum of ranks for the factors being ranked, *m* is number of respondents; and *n* is number of factors being ranked.

The maximum variance (T) is given by:

$$T = m^2(n^2-1)/12 \ldots\ldots (2)$$

$$varT = [\Sigma T^2 - (\Sigma T)^{2/n}] \ldots\ldots (3)$$

Where the variables are as defined above.

The idea behind this index is to find the sum of ranks given to each item (in this case farming practice) being ranked by respondents and then examine the variability of this sum. If the rankings are in perfect agreement, the variability among these sums will be a maximum.

The challenges in soya production were ranked according to the most important to the least important using numerals 1, 2,3, 4,.........n , in that order. The least score rank is the most important while the one with the highest score is ranked as the least important. The total rank score computed is then used to calculate for the Coefficient of Concordance (W) to measure the degree of agreement in the rankings. The limits for W do not exceed 1.00 and cannot be negative. Thus, it can only be positive in sign and ranges from 0 to 1. It will be 1.00 when the ranks assigned by each respondent are the same as those assigned by other respondents and it will be 0.00 when there is a maximum disagreement among the respondents.

Farmers will be asked to rank in order of importance. The challenges will be assigned numbers ranging, 1 to the most important and 5 to the least important. The challenges are as follows: drought/rainfall failure, difficulties in harvesting and threshing, access to tractor services, unavailable labour, high cost of soya bean inputs, poor market prices, pods shattering, diseases and pests, difficulties in planting and access to land for soya production.

The Coefficient of Concordance (W) may then be tested for significance in terms of the F distribution as follows:

$F - ratio(F_C) = (m - 1) \times W/1 - W$...(4)

$$df\ for\ numerator = (n-1) - (2/m)$$

$$df\ for\ denominator = (m-1)[(n-1) - (2/m)]$$

3.9 Theoretical Model for Ordered Logistic Regression

This model is known as the proportional-odds model because the odds ratio of the events is independent of the category. The odds ratio is assumed to be constant for all categories. Ordered logit models are used to estimate relationship between an ordinal dependent variable and a set of independent variables. An ordinal variable is a variable that is categorical and ordered. The probability of a given observation for ordered logit is expressed as follows;

$$P_{ij} = P_r(y_j = i) = P_r(K_{i-1} < X_j\beta + \mu \leq K_i$$

$$= \frac{1}{1+\exp(-K_i + Xj\beta)} - \frac{1}{1+\exp(-K_{i-1} + X_j\beta)}$$

K_o is defined as $-\infty$ and K_k as $+\infty$

3.9.1 Empirical Model for Ordered Logistic Regression

In ordered logit, an underlying score is estimated as a linear function of the independent variables and a set of cut points. The probability of observing outcome I corresponds to the probability that the estimated linear function, plus random error, is within the range of the cutpoints estimated for the outcome.

$$P_r(outcome_j = i) = P_r(K_{i-1} < \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k + \mu_j \leq K_i)$$

μ_j is assumed to be logistically distributed in ordered logit. In either case, we estimate the coefficients $\beta_1 \beta_2 \dots \beta_k$ together with the cut points $K_{1,} K_2 \dots K_{k-1}$ where K is the number of possible outcomes. K_o is taken as $-\infty$ and K_k taken as $+\infty$

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0: Introduction

This chapter presents the results and discussions of the study. Whiles the first part deal with the descriptive analysis of the variables in the study consisting of major socio-economic and demographic characteristics of respondents, the second parts presents other outcomes of the study. In the later, results are discussed in relation to the specific objectives set for the study.

4.1: Socio-Demographic Characteristics of Respondents

This section presents socio-demographic characteristics of respondents. They include the following sex of respondents, age, educational level, marital status, household size, years of experience in soya beans production. The examination of this is important to the extent that it provides guide to the policy makers regarding the adoption of agro inputs, demand and distribution towards farmers' productivity (Table 2)

4.1.1: Sex of Respondents

Results of gender distribution of respondents show that while sixty-nine per cent (69.3%) of respondents were male farmers, almost thirty-one percent (30.8%) were females.

This implies that just as cowpea, soya bean production in northern Ghana has also become male dominated. However, unlike cowpea which is mainly consumed at home, less than 10% of soya bean produced at the family level is consumed at home. Soya bean is increasingly becoming a cash crop because of the availability of market and its relative ease of production; it does not require too much fertilizer like maize and also has fewer insect pests. Again, the higher number of men in relation to women can imply the limited access of women to production inputs like land and credit. Women are normally given smaller parcels of land by their husbands to cultivate vegetables and other crops for home consumption. Majority of them therefore work on their husbands' farm as unpaid family labour (ILO, 2014; FAO, 2011 and UN, 2011).

4.1.2: Age of Respondents

Age is an important socio-demographic variable as it relates to labour input in smallholder agriculture where farmers largely depend on the pool of family labour to meet the labour requirement for their farm operations such as land preparation, planting, weeding, harvesting, just to name but a few which are performed manually in most cases. The mean age obtained for the respondents is 42 years, with a maximum and minimum of 81 and 16 years respectively.

The respondents within the youth age bracket in the study were found to be thirty-six percent (36%). The mean age of 42 years is above the youth age bracket of 15 – 35 years as captured in the Ghana Youth Policy (2010). Age factor can be accounted for years of experience in farming as older farmers are able to identify and cope with situations to enhance their productivity. However, as agriculture in Africa and including Ghana is labour intensive, it may require people who are more energetic as reported by Adeola (2010), that young people are able to withstand stress and spend more time in agricultural operations which can lead to higher productivity. This implies that older people will be disadvantaged in terms of labour contribution to agriculture and hence productivity.

4.1.3: Educational Status of Respondents

This result indicates that more than half of the respondents (58%) producing soya beansin Northern Ghana have no formal education About quarter (25%) of the respondents have attained basic education, 13 percent had secondary education while only 6 percent had tertiary education.

The findings show that both educated and non-educated farmers in soya bean production were involved in the survey. Education plays an important role in agricultural technology adoption. Therefore, in the present study, the ability to use technical information in a print form on agricultural production technologies will not benefit such group of farmers. Many farmers in Africa now have limited sources of agricultural information since they cannot search different avenues ranging from leaflets, bulletins, journals, magazines, manuals, internets among others. Another option for efficiency and effectiveness is the transfer of agricultural technology in local dialects as a communication process to less literate farmers. This is more so in Northern Ghana, where a reasonable percentage of farmers are still illiterate to use technical information in a print form on agricultural production technologies.

4.1.4: Marital Status of Respondents

Results on marital status indicated that majority, (88.8%) of the respondents were married and most household members could be children and dependents of respondents.

This group of farmers by virtue of their position as parents, are required to meet the basic needs of these dependents and hence the need for cash income in order to achieve these responsibilities. Additionally, they have to widen their income sources to enable them pay for agro inputs for soya bean production in order to increase productivity. Similarly, the single, divorced and widowed that are self-dependent will also need increased incomes to meet basic necessities.

4.1.5: Household Size and Soya Bean Production Experience

The results indicate that average household size in the survey was nine (9) people, with a minimum of one person and maximum of twenty (20) people.

In a similar study by Oti-Agyekum (2013) on knowledge, perception and willingness to pay for faecal waste reuse in agriculture by farmers in the Ningo-Prampram and Shai-Osudoku Districts of Ghana, average household size was found to be six. The larger household size in the present study can be linked partly to the practice of polygamous marriages in northern Ghana. Higher households with more adults will increase the contribution of family labour to agriculture compared to households with fewer members. This source of labour is normally unpaid for, therefore, can reduce the total cost of production for soya bean in the study area. However, one negative effect of a larger household size is that it can put pressure on agricultural land resulting in land fragmentation. This condition opposes commercialization of agriculture which is often operated on intensification basis.

4.1.6 Farmers' Experiences in Soya Bean Production

The results show that farmers in the study area have a minimum of one (1) year, a maximum of 25 years with an average of 5 years of experience in soya bean cultivation. This indicates that soya bean production is increasingly becoming more commercial in Ghana even though it has been growing in the country for many years. Even though the crop was introduced in Ghana as far back as 1909, (Mercer-Quarshie and Nsowa, 1974) it was only recently (1990s) that its production assumed commercial status as a result of its promotion by development initiatives and the Ministry of Food and Agriculture. It can also be implied that, farmers who have more years of experience in soya bean production might have identified factors affecting their productivity which will increase their WTP for agro inputs. Tura et al., 2010 hypothesized that farmers having more years of experience is expected to adopt improved maize varieties.

4.1.7: Distance (km) to Nearest Agro Inputs Market

The distance to the nearest agro input market has a significant relation or influence on farmers' production decisions and willingness to pay for agro inputs. The study shows that an average of 5 kilometres (km), a minimum of 0.5 and a maximum of 35 km need to be travelled by farmers to purchase agro inputs for their crop production activities in the study area.

Olwande and Mathenge (2010) and Ariga and Jayne (2006) reported that distance to the nearest agro input market or dealer and poor road network increases transaction and transport cost for acquiring the inputs which can limit their use. Therefore, easy accessibility to agro input markets can increase farmers' willingness to pay for the inputs in soya bean production.

Table 2: Socio-demographic Characteristics of Respondents

Description of variable		Frequency	Percentage
Sex of Respondents			
Male		277	69.25
Female		123	30.75
Total		**400**	**100**
Educational Status		Frequency	Percentage
No formal education		230	57.5
Basic		98	24.5
Secondary		50	12.5
Tertiary		22	5.5
Total		400	100
Marital status			
Married		355	88.75
Single		34	8.50
Divorced/ separated		3	0.75
Widowed		8	2.00
Total		400	100
Description of variable	**Maxim**	**Minimum**	**Mean**
Age (Number of years)	81	16	42
Household size	20	1	9
Experience in soya bean production (years)	25	1	5
Distance to nearest agro input market (km)	35	0.5	5

Source: Field Data, 2015

4.1.7: Farm Sizes of the Respondents

The results show that soya bean production in Ghana is dominated by smallholder as majority of the respondents (81.3%) produce about five acres. (Table 3).

Table 3: Farm Sizes

Farm size (Acres)	Frequency	Percentage
0.5-5	325	81.25
6-10	42	10.50
11-15	19	4.75
16-20	5	1.25
Above 21	9	2.25
Total	**400**	**100**

Source: Field Data, 2015

The results obtained for the study also reveal that some respondents produce at medium and large scale levels in northern Ghana. Farmers therefore need to practice agricultural intensification, which demands the application of agro inputs such as inoculants, certified seeds, and fertilizer among others. Also, the small holdings could mean that there is pressure on farm/agricultural land once most of the household members are not engaged in off-farm income ventures as major occupation.

4.1.8: Farmers' Involvement in Off-farm Income Activities

Results also revealed that 57.8% of respondents were engaged in off farm income generating activities. This can influence farmers' willingness to pay for agro input in soya bean production as extra income can be used to purchase the required agro inputs.

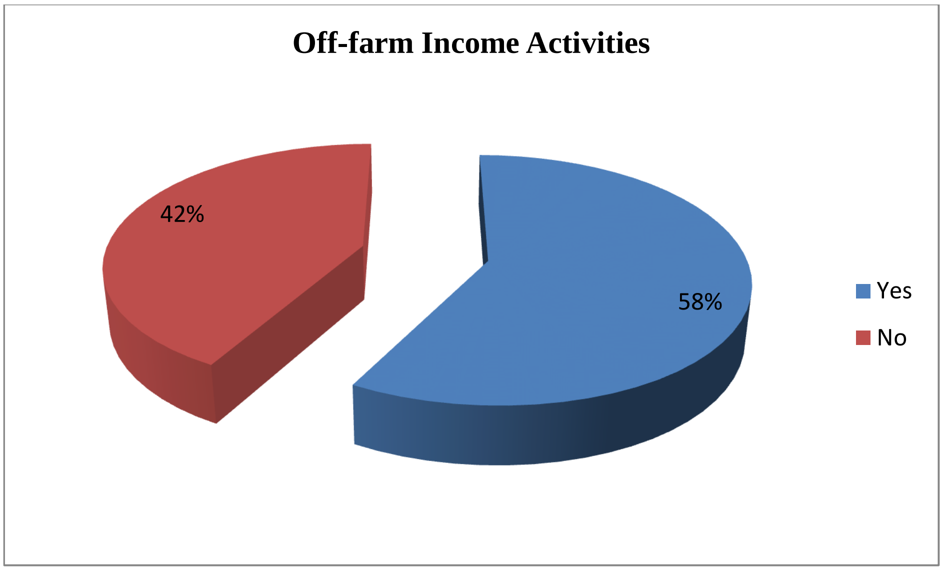


Figure 1: Farmers' Involvement in Off-farm Activities

Source: Field Data, 2015

Studies by Diiro (2013) showed that, off- farm income in a way provide farmers with liquid capital for purchasing agro inputs. He found a higher rate of adoption among households with off-farm income than those without. This is more important in economies where farmers' access to credit is limited. However, the negative effect of excessive search for off farm income could also cause labour shortage especially at the peak of the cropping season. This is true in northern Ghana where youth rural-urban drift to the south for off farm income is very high and has become a norm attracting public discussion.

From the focused group discussions, the main off farm activities of respondents included petty trading, artisanal or craft works, herbal medicine preparation, security jobs and formal jobs either in the public or private sectors.

4.1.9: Farmers' Production Activities in northern Ghana

To investigate the willingness to pay for agro input in soya bean production in northern Ghana, respondents were asked to give various crop and livestock production activities they were engaged in. Details of the production activities of respondents are presented in Figures 2 below

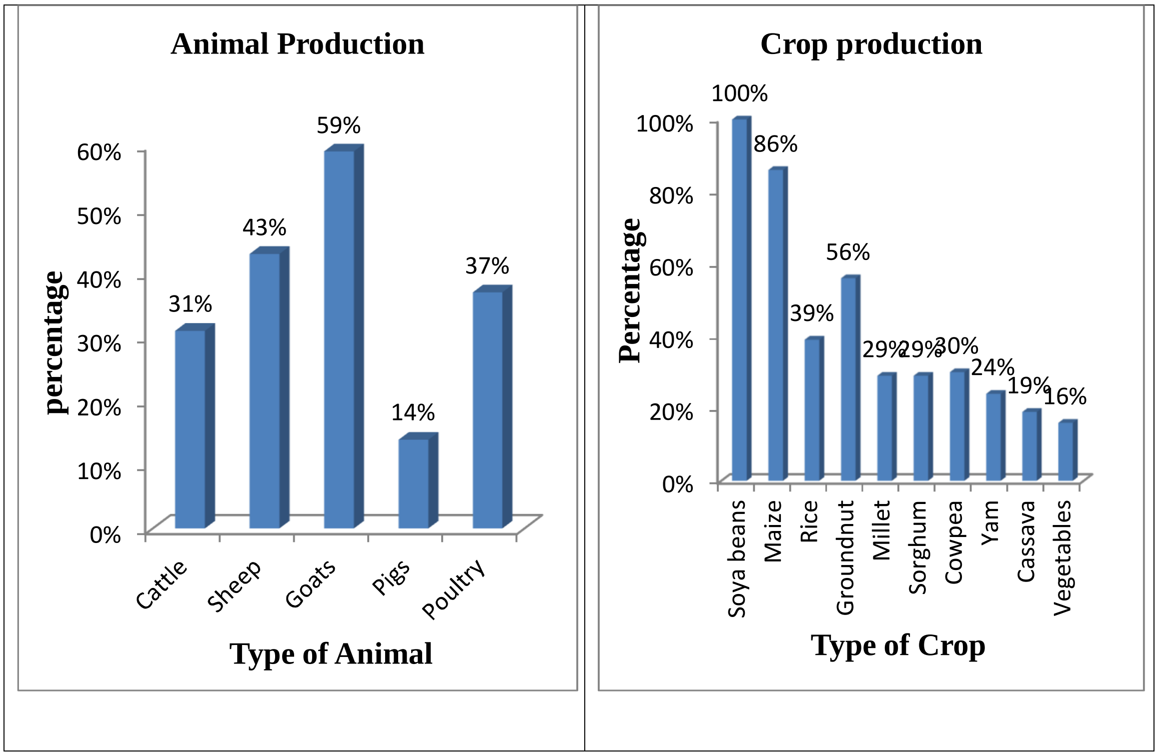


Figure 2: Farmers' Production Activities in Northern Ghana

Source: Field Data, 2015

The results show that respondents are involved in other different production enterprises aside soya beans cultivation ranging from crops such as maize to livestock such as sheep and goats. For maize 345 (86.3%) and for goats 235 (58.8%) respondents respectively are the highest production ventures in terms of crops and livestock among the respondents.

The high number of farmers engaged in maize production can be attributed to its consumption as a staple food by the majority of the population and its role as cash crop while that of goat production is due to its adaptability to varied environmental conditions as well as its prolific production ability. Although, some people participated in vegetables and pig production, these two were on a lower scale. While the low participation in vegetable production was partly due to its unprofitability that of pig production was mainly due to religion as majority of the population are Moslems. Diversification of production can be of advantage in two ways: reduction of risk level associated with crop failure as a result of adverse weather conditions and increased and continuous sources of income.

4.2: Farmers Reasons of Soya Bean Production

The results indicate that all the respondents (100%) in the study grow soya bean for sale while (5.75%) use it for food (Table 4.)

Table 4: Farmers Reasons of Soya Bean Production

Purpose	Frequency	Percentage
Cash	400	100
Food	23	5.75
Seed	6	1.5
Food / cash	82	20.5
Seed/cash	14	3.5
Food/cash/seed	34	8.5

Source: Field Data, 2015

The result agrees with Sherry-Lee (2010), that soya bean can be used as staple food for a variety of dishes and as cash crop with local and international demand and as raw material for cooking oil and livestock feed industries. The higher percentage of people cultivating soya for cash implies that farmers are trying to diversify their production and spread their risk. This is very important in the face of climatic variability and poor soils conditions where the yields of major traditional cash crops such as maize, groundnuts and rice are declining year after year.

4.2.1: Farmers Awareness of Agro Inputs for Soya Bean Production

For adoption of a particular technology to take place, the adopters (in these case soya bean farmer) go through a series of stages before finally adopting. It was observed in the survey that certified seeds of improved varieties used by respondents (73.5%) were the highest known agro input for soya bean production and insecticides (21.75%) was the least known input (Figure 3).

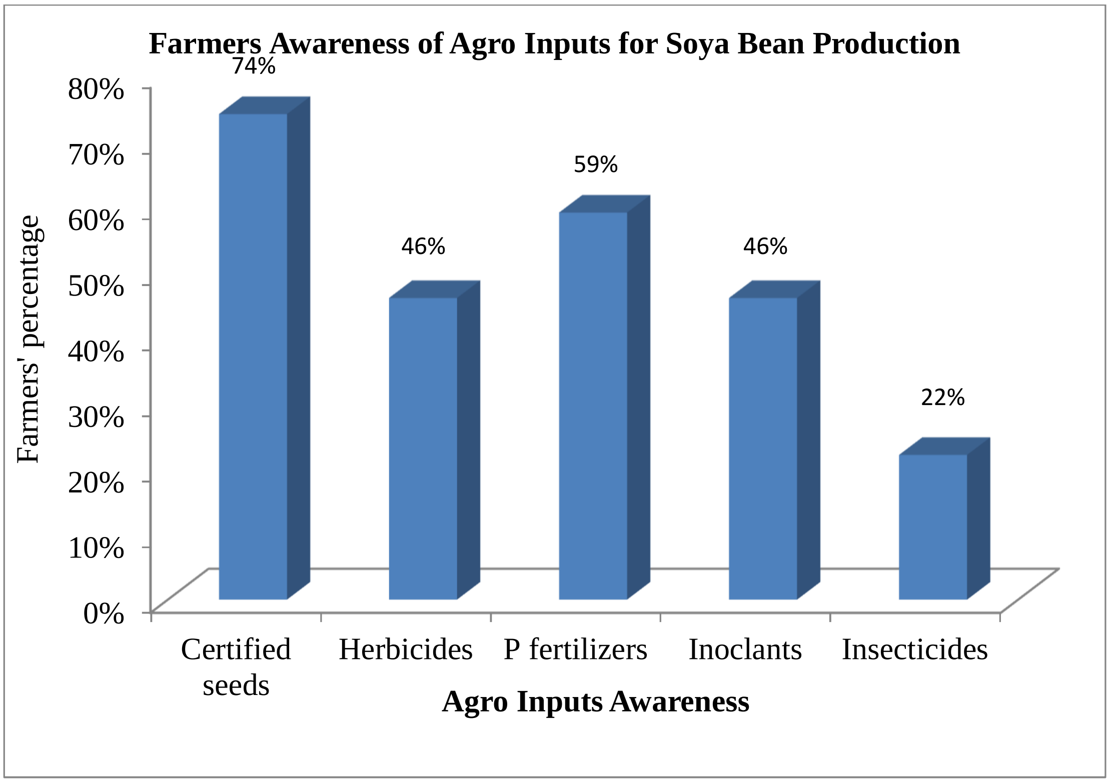


Figure 3: Farmers Awareness of Soya Bean Inputs

Source: Field Data, 2015

The higher degree of awareness in improved seeds and herbicides can be linked to their familiarity with similar inputs and mode of application for other crops such as maize and rice. The results corroborates with studies by Rogers (1995) and Jayne Mugwe et al.,(2002) that suggests adopters initial exposure to an innovation enable them to form some attitudes toward it by seeking more information about how it works, its benefits and costs associated with it.

4.2.2: Agro Inputs Employed in Soya Bean Production

Figure 4 shows that farmers own seed are grown by many (95.3%) respondents, certified seed grown by 45.5% respondents, herbicides (46.8%), fertilizer (35.5%) and inoculants (29%) were the major agro inputs applied to soya bean fields in 2015 cropping season.

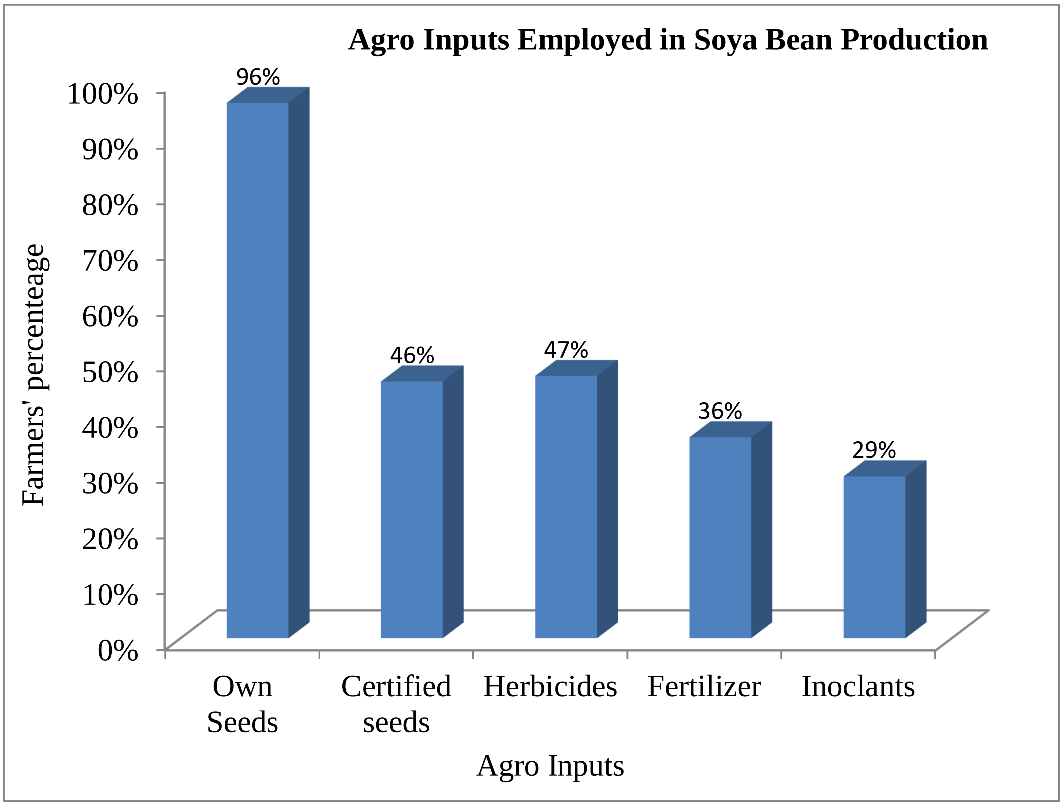


Figure 4: Agro Inputs employed in Soya Bean Production

Source: Field Data, 2015

Although majority of the respondents used improved seeds, their sources of supply indicated that the seeds were their own seeds that have been recycled for a number of seasons. The most frequently used improved variety by farmers was Jenguma. Jenguma is an improved dual-purpose soya bean variety developed by the Savanna Agricultural Research Institute (SARI) of the Council for Scientific and Industrial Research (CSIR) in Ghana and it is very popular among soya bean farmers in northern Ghana because of its resistance to shattering. From the focus group discussion, the farmers gave high yielding and non-shattering of pods when dried as reasons for its preference among smallholder farmers. They further explained that harvesting normally occurs at the onset of the harmattan in November and December and during this period the area experiences annual bush fires. Therefore, farmers tend to harvest their grains and cereals such as maize and rice which are more susceptible or prone to bush fires before soya bean. The herbicide commonly used in soya bean production is glyphosate which has different trade names but farmers popularly call them "kondem" meaning complete/total weed killer. It is applied as a pre-emergence chemical in soya bean fields to control weeds which can compete with the crops for water, sunlight and nutrients at the early stages.

4.2.3: Farmers Sources of Information on Soya Bean Agro Inputs

The results indicate that MoFA leads (20.8%) as the major source offarmers' information on fertilizer while NGOs top as the major source of information on improved seeds (21.8%) and inoculants (15%). Agro input dealers and radio stations are major sources of farmers' information on herbicides among respondents.

Agro-input dealers are also a major stakeholder in the delivery of agricultural information to farmers especially in most rural areas where agricultural extension agents arerare (Figure 5).

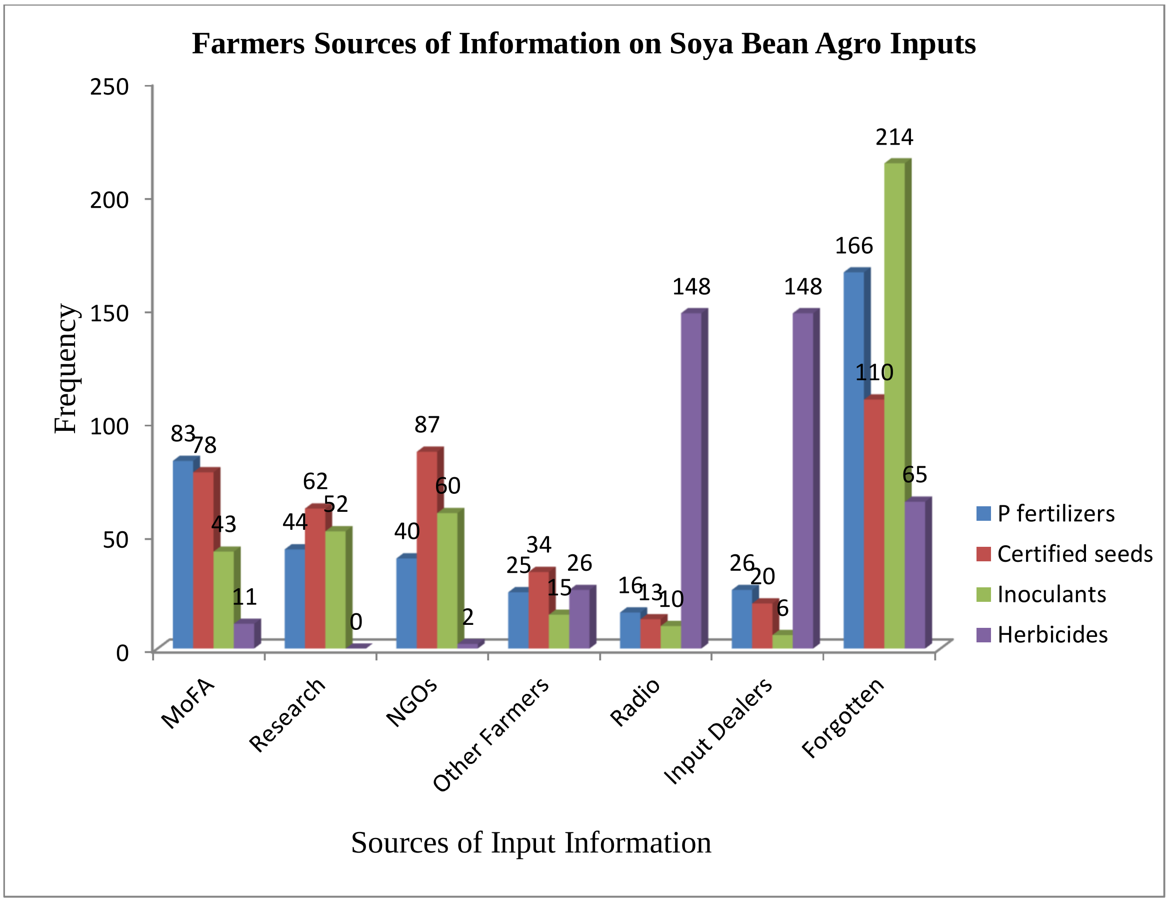


Figure 5: Farmers Sources of Agro Inputs Information

Source: Field Data, 2015

In rural communities, they are the first people farmers come into contact with whenever they need any information on agricultural inputs. Similar studies by Oti-Agyekum, (2015) suggest the media as the main source of farmers' knowledge in faecal compost as organic fertilizer in crop production. MoFA's lead in fertilizer information can be linked to the past where agricultural development was a sole responsibility of the state and agro inputs including mineral fertilizers were controlled and distributed by MoFA. In northern Ghana, NGOs are major stakeholders in the promotion and utilization of agro inputs through the demonstration of improved technologies including the use of improved varieties and inoculants. It is therefore not surprising that they were mentioned by farmers as the major source of information on the use of improved seeds and inoculants. The mentioning of the radio as the major source of information on herbicides is partly due to the fact that herbicides utilisation is being promoted by private businesses who normally advertise on local radios.

4.3:Participation of Farmers in Soya Bean Field Demonstration

The study revealed that out of the 400 total respondents, 268 representing (67%) had ever attended or participated in a soya bean demonstration activity (Figure 6)

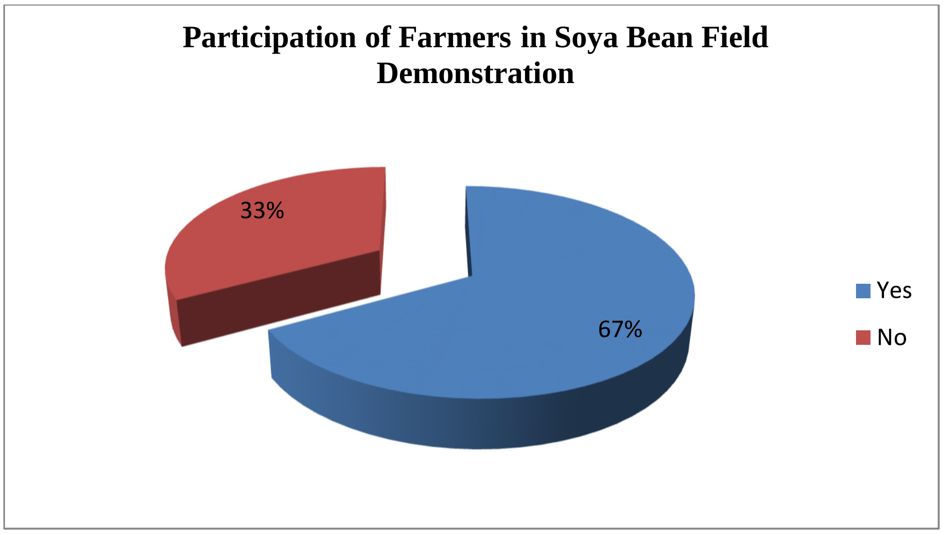


Figure 6: Respondents participation in soya bean field demonstration

Source: Field Data, 2015

This partly explains why there is high level of awareness among the sampled farmers in agro input usage for soya bean in the study area. Lessons learnt, through the discussions and observations during field school demonstration sessions were found to have helped farmers to adopt technologies demonstrated and also influence their willingness to pay for agro inputs.

4.3.1: Gains Made by Respondents in Soya Bean Demonstration Field Schools

For those who normally participate in farmer field schools, the results on gains made in those sessions show that (51.5%) of them learnt something about application of agro inputs and agronomic practices through which they exhibited the awareness of certified soya bean seeds, TSP fertilizer, inoculants and herbicides Table 5.

Table 5: Gains Made at Demonstration Field Schools

Gains made	Frequency	Percentage
Application of agro inputs	36	9.00
Agronomic practices	170	42.50
Nutritional value	15	3.75
Harvesting and processing	29	7.25
Storage	5	1.25
Marketing	4	1.00

Source: Field Data, 2015

The agronomic practices include time of planting, row spacing, plant spacing and weeds control. Other gains made by such participants include nutritional value of soya bean in household 3.75% diet, while 9.5% of them gained ideas related to harvesting and processing, storage and marketing.

4.3.2: Farmers Ranking of Agro Inputs Effect on the Yield Capacity of Soya Bean.

The perspectives of farmers on the influence of agro inputs on yield of soya bean show that certified seeds of improved varieties is the highest rated input (76.25%) likely to influence soya bean yield Table 6.

Table 6: Farmers Ranking of Agro Inputs Effect on Soya Bean Yield

Agro inputs	Frequency	Percentage	Rank
Inoculants	179	44.75	4th
Fertilizer	282	70.5	2nd
Certified seeds	305	76.25	1st
Herbicides	193	48.25	3rd
Insecticides	92	23	6th
Manure	135	33.75	5th

Source: Field Data, 2015

Other rates given by respondents are fertilizer (70.5%), herbicides (48.25%), inoculants (44.75%), manure (33.5%) and pesticides (23%) in that descending order of importance. The high ratings of improved seeds, fertilizer, herbicides and inoculants can be attributed to farmers' active participation in soya bean field demonstrations where the influence of these agro inputs on soya bean yields are demonstrated. On the other hand, the result can also be linked to farmers' use of similar agro inputs for other crops such as maize and rice.

4.3.3: Farmer Expectation on Output at Planting and Harvesting

The result of farmer expectation of soya bean output per acre at the time of planting and harvesting given by respondents revealed a maximum of 2.8 metric tons (MT) and a minimum of 0.4 MT with an average of 1.0 MT Table 7**.**

Table 7*: Farmers Expected Yield per Hectare at Planting and Harvesting*

Expected out put	Minimum (MT)	Maximum (MT)	Mean (MT)
Time of planting	0.4	2.8	1.0
Current stage	0.4	2.0	0.76

Source: Field Data, 2015

When respondents were asked to give the expected yield at the current stage (whether crop is harvested or still in the field to be harvested at the time of data collection) however, results obtained was maximum 2.0 MT, minimum of 0.4 MT and an average of 0.76 MT.This average expected yield of 0.76 MT of soya bean, as given by respondents, at the current state of production without the required agro inputs, is much lower than the national average of between 1.3 to 1.5 metric tons per hectare in 2000 and 2010 (Tweneboah, 2000; MoFA, 2010), and Africa's average of 1.1 tons per hectare (IITA, 2009). The result is a proof that for farmers to attain the average yield as envisaged by research, application of appropriate technologies with soya bean inputs is essential.

4.3.4: Distribution of Farmers Based on Reasons for Soya Bean Yield Difference

Many respondents (56%) associated their yield variation to drought conditions as well as poor soil fertility, disease and insect pests. Other reasons given were delays in weed control, insufficient agro inputs usage and poor germination of seeds Table 8.

Table 8: Farmers Reasons for Yield Difference at the Planting and Harvesting Time

Reason	Frequency	Percentage
Delayed planting	13	3.3
Drought condition	223	55.8
Disease and insect pests	23	5.8
Pods shattering	7	1.8
Poor germination	18	4.5
Poor soil fertility	43	10.8
Weeds control and agro input applied	20	5.0
No idea	53	13.3
Total	**400**	**100**

Source: Field Data, 2015

Few of the farmers (about 2%) asserted that pod shattering is a major reason for yield variation while 13% had no idea about the causes of the yield difference between their expectations and the actual output obtained after harvest. The results show that soya bean farmers are aware that sufficient rainfall or moisture during the growing season, early planting and effective weed control using required herbicides at the recommended rates do enhance good germination and result in high productivity. About 13% of the farmers had no idea as to what causes the yield difference and can be attributed to their years of experience in soya bean production. There is the probability that they have fewer years of soya bean production to know the factors that affect yield in soya bean cultivation.

4.3.5Farmers Rating of Expected Soya Bean Yield at Harvest

The result shows that most of the respondents (43.5%) rated their yield as medium or average followed by low (34.3%) and 13% as high (Table 9).

Table 9***: Farmers Rating of Expected Soya Bean Yield at Harvest***

Ratings	Frequency	Percentage
High	55	13.8
Medium	174	43.5
Low	137	34.3
Crop failure	18	4.5
Cannot tell	16	4.0
Total	**400**	**100**

Source: Field Data, 2015

4.4: Challenges in Soya Bean Production

Access to credit or agricultural finance is often cited by farmers as a major challenge confronting them with little consideration to other challenges when asked about challenges faced by farmers in Africa including Ghana (Salami et al., 2010). Therefore this study kept finance as a constant challenge affecting all the respondent farmers to enable them bring out other problems they are facing in soya bean production.

4.4.1 Differences in Perceptions of Challenges in Soya Bean Production among Farmers

The study revealed that farmers perceived drought/rainfall failure as the most important challenge in soya bean production (Table 10).

Table 10: Sum of Ranks of Perception of Challenges in Soya Bean Production

Challenges	Mean Score	Rank
Drought/Rainfall failure	4.63	1
Difficulties in harvesting and threshing	4.67	2
Access to tractor services	4.98	3
Unavailability of labour	5.03	4
High cost of soya inputs	5.19	5
Poor marketing price	5.31	6
Pods shattering	5.48	7
Difficulties in planting	6.34	8
Access to land	6.49	9
Diseases and pest	6.89	10

m = **400**, n = **10**, W = **0.075**, Chi-Square = 268.554, df = **9**, Level of Significance = **0.000**
Source: Field Data, 2015

Since W=0.075>0(W is the Kendall coefficient of concordance index that measures the ratio of the observed variance of the sum of ranks and the maximum possible variance of the sum of ranks) we can confirm that there is a degree of agreement among soya bean farmers' knowledge and perception in challenges they face in production as Kendall's coefficient of concordance is greater than zero (0).

The implication is that farmers do obtain better output with higher rainfall during the copping season as soya is grown under rain-fed conditions in Northern Ghana.

The difficulties in harvesting and threshing were ranked second by the farmers in the study due to the high stress involved in these activities. Thus, it can reduce farmers' interest in cultivating soya on large scale and hence losing its benefit as a cash income earner, as an important nutritional source for the household. It is also an important source of nutrition for livestock especially poultry as well as ameliorating the declining soil fertilities of farm lands as a nitrogen fixing legume when grown in rotation with other crops.

Inaccessibility to tractor services to plough fields for planting was ranked a 3rd challenge in soya production. Tractor services have a great influence on time of planting to capture the full benefit of the rainfall within the shorter planting window since rainfall period northern Ghana is the shortest in the country. The inability to access tractor services is a more common problem among women farmers in Ghana. Additionally, this problem leads to poor germination of seeds planted and impacting negatively on yields when soils are not well prepared.

Unavailability of labour ranked fourth among the challenges by the respondents. Labour is an important input in soya bean production right from planting to harvest and threshing. Therefore, labourshortage do significantly affect performance of certain activities.

High cost of soya inputs was ranked the fifth challenge. Application of appropriate technologies in crop production in this era of climate change is very important for the attainment of optimum yield. However, the use of these new technologies like certified seeds, row planting, row spacing and others do require the use of supplementary agro inputs. The related problem however is that, farmers are constrained by their inability to purchase inputs at high prices for soya bean production and in effect lead them to low productivity year after year.

The sixth ranked challenge was lack of remunerative market price of soya bean. Farmers in Ghana are motivated to produce to the market price of agricultural commodities, implying that farmers always diversify their production system and move into the production of other crops that have remunerative prices on the market. In that regard, soya bean production can be abandoned in some years.

According to Table 13, 42% of the respondents in the study area considered drought/rain failure as the most important challenge confronting them, this is followed by difficulties in harvesting and threshing, 150 (37.5%) and access to tractor for ploughing;100 (25%). These results are similar to those reported by farmers during focus group discussion sessions where drought/rain failure, difficulty in harvesting and threshing and access to tractor for ploughing were ranked 1st, 2nd and 3rd challenges respectively. Although access to land was mentioned as a challenge in the cultivation of soya bean, it was mentioned by only 9% of the respondents.

However, according to the report of MEDA GROW (2015), women farmers along the soya bean value chain are faced with challenges such as limited access to fertile and productive land where customary ownership of land rest in the hands of men. As a result, to secure some parcels of land from their husbands and family heads in some cases they are offered infertile and abandoned lands that are difficult to prepare for planting. Also, limited access to labour saving technologies such as tractor and thresher services as well as agro inputs are among challenge hindering soya bean producers in northern Ghana especially among women farmers. The MEDA GROW report stated that threshing of soya has been the main challenge offarmers over the years and at times do not make the enterprise attractive for some people.

4.5: Profitability Analysis of Soya Bean Production

The performance and sustainability of any business enterprise depends significantly on the accrued profit within a specified period of time. Generally, profit is the sum of money received from the output produced minus the cost of the production. The profitability of any business venture controls or determines its survival, thus either it makes gains or losses in its operation at certain stages.

From Table11, Total Variable Cost is the operating costs of the respondent which constitute all costs incurred in producing soya bean till it gets to market. The Total Variable Cost incurred by the respondents averaged GH¢340/acre, with an average Gross Income (GI) of Gh¢ 600, which valued a Gross Margin (GM) of Gh¢260/acre.

Soya bean farmers depend on both family and hired labour for their farming activities. It was found in the survey that family labour was the major source of labour for soya bean production. This source of labour is normally unpaid for, but introducing the principle of opportunity cost, family labour was substituted for hired labour.

Table 11: Gross Margin Analysis of Soya Bean Production

Activity/Item	**Input Qty. / Land size**	**Unit price GH₵**	**Total GH₵**
Ploughing	1 acre	50	50
Seed	12.5kg/5bowls	4	20
Planting	1 acre	50	50
Weeding	1 acre	50	50
Harvesting	1 acre	50	50
Threshing	5 women	6	30
Winnowing	5 women	4	20
Sacks (for bagging)	5	3	15
Transport (from farm to home)	5	2	10
Feeding (for totallabour)	-	-	50
Total Variable Cost (TVC)	-	-	**340**
Total Revenue (PQ)	5 bags	120	**600**
Gross Income (TR-TVC)	-	-	260
Return per cedi invested (GM/TVC)	-	-	0.76

Source: Field survey (2015)

As a result, family labour cost equates prevailing wage rates of hired labour. The proportion of major components in the TVC include ploughing, seeds (from local market, nearby research and agricultural offices), labour costs for; planting, weeding, harvesting, threshing, winnowing and transportation of the produce from farm to home. The major means of transport in the study area were tricycles and donkey carts. The analysis revealed that labour is the most used input among the respondents and accounted for 71.8% of the total cost of production among soya bean farmers. This conforms to the study of Bamidele (2008) where labour cost dominates the Total Variable Cost of Cassava-Based Production Systems in the Guinea Savannah of Nigeria, accounting for over 80% of the TVC.

4.6: Willingness to Pay for Agro Inputs

The results show that nearly three quarters (74%) of the respondents were willing to pay for soya bean inputs while 26% were not willing to pay for soya bean inputs Figure 7**.**

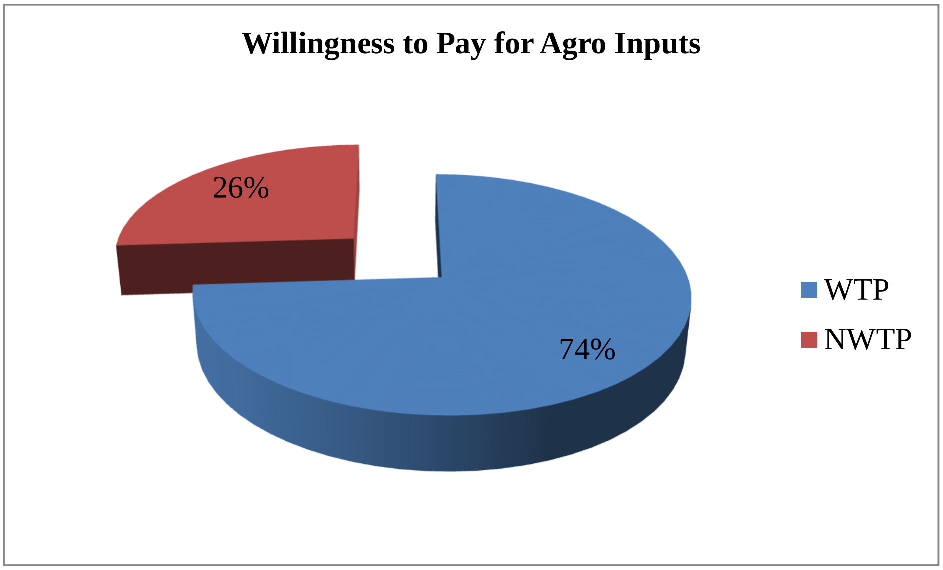


Figure 7: Farmers' Willingness to Pay for Soya Inputs

Source: Field Data, 2015

This result is similar to observation made by Meseret (2014) that shows that more respondents were willing to pay for irrigation water use than non-willing group. The results presented in (Table 15) also show that regionally, 83% of the respondents in the Upper East and West regions were equally willing to pay while 17 % were not willing to pay. In the Northern region 66% respondents were willing to pay whereas 34% were not willing to pay for soya bean inputs. This means that farmers in the Upper regions have identified the need to apply appropriate technologies in soya production than their counterparts in the Northern region**.**

Male and female farmers' willingness to pay was the same (Table 12) and their responses were 75% yes and 25% no.

Table 12: Willingness to Pay by Region and Sex

Region	**Yes**		**No**		**Total %**
	Frequency	**%**	**Frequency**	**%**	
Northern	140	66	72	34	100
Upper East	93	83	19	17	100
Upper West	63	83	13	17	100
Total	**296**		**104**		**400**
Sex	**Yes**		**No**		**Total %**
	Frequency	**%**	**Frequency**	**%**	
Male	208	75	69	25	100
Female	88	72	35	28	100
Total Frequency	296		104		100

Source**:** Field Data, 2015

4.6.1: Willingness to Pay at the Bid Prices (Market price)

Results from the survey show that 172 (43%), 189(47.25%), 158(39.5%) and 198 (49.5%) of the respondents were willing to pay at the bid prices of 4, 15, 120 and 20 Ghana Cedis for certified seed, herbicides, TSP and inoculants respectively. At the same time, 3%, 4%, 21.25% and 8.75% of farmers interviewed were not willing to pay any amount at all for certified seed, TSP, herbicide and inoculants respectively (Table 13).

Table 13: Willingness to Pay at the Bid Prices

Inputs	Bid price (Gh¢)	Frequency	Percentage
Certified seed (per kg)	4	172	43.0
Herbicides (per litre)	15	189	47.3
TSP (per 50kg)	120	158	39.5
Inoculants (100g)	20	198	49.5

Source: Field Data, 2015

4.6.2: Maximum Willing to Pay for Soya Inputs

Table 14 depicts summary distribution in the maximum amount respondents were willing to pay for the various agro inputs

Table 14: Summary of Top Limit Payment of Respondents for Soya Bean Inputs

Certified Seeds			TSP			Herbicides			Inoculants		
Amt GH¢	Frq	%	Amt GH¢	Frq	%	Amt GH¢	Frq	%	Amt GH¢	Frq	%
0.00	12	3	0.00	16	4	0.00	85	21	0.00	35	9
1-1.5	24	6	40-50	33	8	5-10	79	20	1-5	5	1
2-2.5	99	25	60-70	66	17	11-14	47	12	6-10	62	16
3-3.5	83	23	80-90	83	21	15.0	189	47	11-15	83	21
4.00	172	43	100-110	44	11	-	-	-	16-19	17	24
-	-		120.00	158	40	-	-	-	20.00	198	50
Total	400	100		400	100		400	100		400	100

Source: Field Data, 2015

Table 14 depicts summary distribution in the maximum amount respondents were willing to pay for the various agro inputs. Besides the 43%, 39.5, 47.3%, and 49.5% of respondents who were willing to pay the bid price of 4, 120, 15 and 20 Ghana Cedis, for certified seeds, TSP fertilizers, herbicides and inoculants respectively, others were not willing. Among the respondents, 57%, 60.5%, 52.7% and 50.5% who were not willing to pay the "bid price" the mode willingness to pay amounts were in the ranges of 2-2.50, 80-90, 5-10 and 11-15 Ghana Cedis for the afore mentioned soya agro inputs respectively.

The mean amount respondents were willing to pay were 2.38, 75.55, 10.21 and 12.40 Ghana Cedis with standard deviations of 0.65281, 17.94508, 1.89992 and 3.27837 for certified seeds, TSP fertilizer, herbicides and inoculants respectively (Table 15).

Table 15: Mean Amounts Respondents Willing to Pay for Soya Bean Inputs

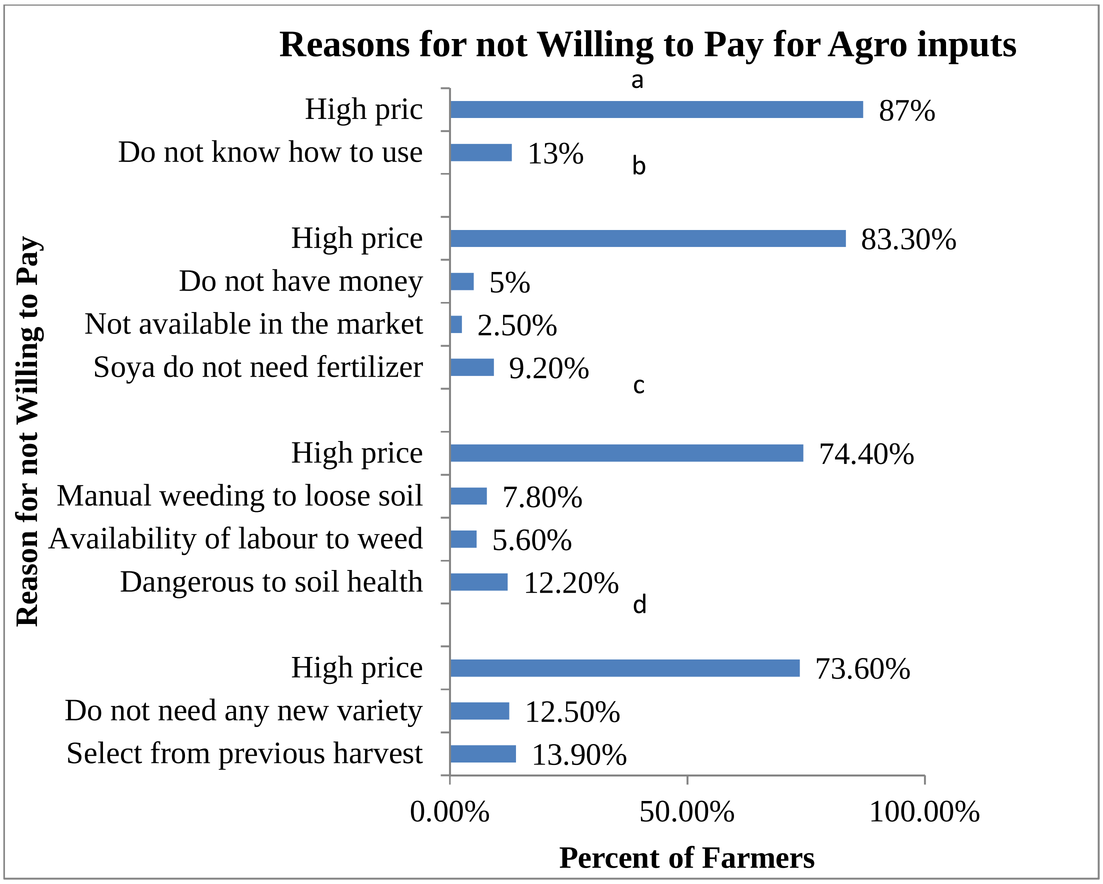
Input	Average Price	Standard Deviation
Certified Seeds	2.38	0.65281
Inoculants	12.40	3.27837
Glyphosate	10.21	1.89992
TSP fertilizer	75.55	17.94508

Source: Field Data, 2015

The mean WTP amount constitutes about 59.5%, 62.96%, 68.07% and 62% of the total price of the respective agro inputs under study. This finding is contradicts Kumar et al., (2011) that farmers have no felt need to buy veterinary services package for their livestock.

4.6.3: Reasons Why Some Farmers Were Not Willing To Pay Soya Bean Inputs

The study tried to identify the reasons why some respondents were unwilling to pay for soya bean inputs and the results are presented in the Figure 8. The main reason for their unwillingness was high price of the inputs. Singularly on inoculants, lack of knowledge in the application and storage were the reasons. Cash constraints, non-availability in the market and ability of soya bean to grow without fertilizer were the reasons respondents were not willing to pay TSP fertilizer. For herbicides, the reasons include preference for hand weeding to loose soil, availability of family labour and the fear of adverse effect of chemical on soil health while for seeds respondents have no felt need for new varieties as they could select good seeds from previous harvest.



a=inoculants, b=TSP, c=herbicide andd=certified seeds

Figure 8: Reasons for Not Willing to Pay

Source: Field Data, 2015

4.6.4: Factors Influencing Willingness to Pay for Soya Bean Inputs

In this section estimates of the variables of the logit model for willingness to pay for agro inputs are presented. At the beginning of the study the consent of all respondents was sought and they were all willing to participate in the process. Asking responding farmers their willingness to pay for agro inputs (certified seeds, TSP, herbicide and inoculants) in general for soya bean production, 43%, 39.5%, 47.3% and 49.5% respectively replied 'yes' they were willing to pay for the inputs at the "bid" price of 4, 120, 15 and 20 Ghana Cedis respectively . However, 57%, 60.5%, 52.7%h and 50.5% said that they were not willing to pay for certified seeds, TSP, herbicide and inoculants at the "bid" price respectively.

Factors Influencing the Amounts Respondents Willing to Pay for Soya Bean Inputs

The dependent variable used in this model was a continuous variable that farm households stated as the maximum amounts they were willing to pay (WTP) in Ghana Cedis (GH¢). From the ordered Logit Table 19 below, ten (10) independent variables were used to determine their willingness to pay for the four agro inputs. These 10 hypothesized independent (explanatory) variables were found to be statistically significant for some of the agro inputs under study. The variables were age of respondent, household size, farmer group membership, and farmer access to agricultural extension service, access to credit and purpose of soya bean production. Others include farmer participation in soya bean field demonstrations, and gains made from participating in soya demonstrations, distance to the nearest agro input dealers and farmers years of experience in soya bean production.

Table 16: Logit estimates of factors influencing the farmer WTP

Variables	Coefficient	Standard error	p-value
Age	.0180231* (a) .0029065 (b) -.0047452 (c) -.0199225** (d)	.010549 .00818689 .0080686 .0084059	0.088 0.723 0.556 0.018
Household size	-.0813126*** (a) -.0600813** (b) -.0115071 (c) .0104016 (d)	.031107 .0240951 .0231427 .0240169	0.007 0.013 0.619 0.665
Group membership	-.141654 (a) -.2777872 (b) .3322483 (c) -.5625232** (d)	.2961583 .2303879 .2212829 .2228006	0.632 0.228 0.133 0.012
Access to extension	.0760693 (a) .0253671 (b) -.3725557* (c) .0692203 (d)	.2718554 .2186784 .2100805 .2149265	0.780 0.908 0.076 0.747
Access to credit	.3071022* (a) -.2062899 (b) -.0701908 (c) -.3563499*** (d)	.1807196 .1297166 .1231982 .133225	0.089 0.112 0.569 0.007
Purpose of soya production.	.0558065 (a) .1372797** (b) .0826521 (c) -.0515534 (d)	.0784644 .0604867 .0594985 .0604729	0.477 0.023 0.165 0.394
Participation in soya demo	1.187314*** (a) .078108 (b) -.6981493*** (c) -.4584043 (d)	.3406674 .2641313 .2609837 .2631549	0.000 0.767 0.007 0.082
Gains from demo participation	-.3079774*** (a) -.0107426 (b) .2533532*** (c) .0758375 (d)	.0919199 .078045 .0758103 .0751725	0.001 0.891 0.001 0.313
Distance to input market	-.01506611 (a) -.0098871 (b) -.0525811** (c) .0089961 (d)	.0267423 .0204731 .0226422 .0205636	0.573 0.629 0.020 0.662
Soya farming experience	.0182661 (a) .1027407*** (b) .0157959 (c) .0489796** (d)	.029088 .0236164 .021768 .0225551	0.530 0.000 0.468 0.030

Note:*, **, and *** indicate 10%, 5%, and 1% significant levels respectively where a, b, c and d represents Certified seeds, Glyphosate, TSP and Inoculants.

Source: Field Data, 2015.

Log likelihood =-497.78129; Pseudo R2=0.0393; LR Chi^2 (10) 40.74; Prob> $Chi^2$0.0000

For certified seeds, the significant variables were age of the farmer, household size, and access to credit, participation in soya bean field demonstration and the gains made from participating in demonstrations. The significant levels were 10% for age and access to credit, 5% for household size and 1% for participation in soya bean field demonstrations and the gains made from them. Household size, purpose of soya bean production and experience in soya ban production were determinants of willingness to pay for glyphosate. Household size and purpose of soya production were statistically significant at 1% level. However, access to agricultural extension services (10%), participation in soya 5% and farmers' years of experience in soya bean demonstration (5%), and lessons learnt from the demonstration (1%) and distance to the nearest agro input dealers, influence willingness to pay for triple superphosphate (TSP). Also, age, access to credit, farmer group membership, and participation in soya bean demonstration and experience in soya bean production were also found to influence farmers' willingness to pay for inoculants. Access to credit was 1%, age, farmer group membership and experience in soya bean production at 5% and participation in soya field demonstration at 10% statistical significant levels.

Age of farmer: Another important factor revealed by the study, to influence farmers' willingness to pay for agro inputs in soya bean production is the age of farmer. It was positively influencing certified seed while in the case of inoculants the effect was negative. Positive result indicates that an additional increase of farmer's age increases the probability of his/her willingness to pay for agro inputs. As the age of a farmer increases, the willingness to pay for soya inputs increases significantly. The reason is that, older farmers have a better control over certain resources and therefore will be willing to pay for an input compared to younger counterparts who do not control much resource. However, the negative relationship obtained implies that the younger the farmer the more willing he or she is prepared to pay for the inputs. In consonance, Chirwa (2005) reported that older farmers were less likely to adopt hybrid seeds technology than the younger ones. Therefore, younger farmers will be more willing to pay for soya bean inputs as they are less averse to take risk and have more years to plan and stay in farming than the aged (Gockowski and Ndoumbe, 2004). Hassen *et al,* (2012), also found age as an important factor for adoption.

Household size: This variable was significant at 5% probability level and has negative relation with respondents' willingness to pay for agro inputs. Implication of the result is that individual with larger household members will be financially constrained as they have financial responsibilities towards the family. Therefore an increase in the household number will increase household expenditure and negatively influence the WTP for soya inputs. Contrary to this results, Oti-Agyekum (2015) found this variable to be significant and positively related with an assertion that by intuition households with more people have to meet household food and material needs. Therefore, larger households would have to increase their incomes in order to get more inputs to boost their yield.Amaza et al., (2014) also indicated that household size determines agricultural labour, farm size and amount of produce retained for home consumption. Therefore, households with fewer members will experience labour deficit or shortage than the larger households and hence smaller farm sizes. Households with labour shortage will not be willingness to pay for soya inputs as soya beans production is labour intensive right from planting to processing. On the other hand, in a fewer households the quantity of produce kept as food for home consumption will be low as more can be sold to get higher income to pay for soya inputs.

Access to credit: Credit was observed to be statistically significant at 10% probability level with positive influence on willingness of respondents to pay for required agro inputs for soya bean production. An increased in the farmer's access to credit facility will increase his or her WTP for soy input. One of the frequently cited challenges among smallholder farmers in Africa is financial constraint on account of lack of collateral security (FAO, 2015; Salami et al., 2010). Therefore, any intervention in the form of credit will help farmers to adopt modern agricultural technologies in the face of present climate variability to increase their productivity per land area. This indicates that, all things being equal, farmers who have access to credit have a higher likelihood of being more willing to paying for soya inputs than their counterparts who do not have access to credit. Once farmers are not able to obtain credit from either the formal or informal sectors, the adoption of new agricultural technologies will not be achievable.

Participation in soya bean demonstrations and gains made from them: These variables were statistically significant at 1% levels. Famers who had ever attended soya bean demonstration field days either on their own farm or on other farmers' farm to observe are more likely to appreciate the influence of these vital inputs. This is more evident from yield performance compared to their traditional system where these agro inputs are not applied to soya bean. Also, through the explanations and practice of how these inputs are applied in the field situation, all doubts in the minds of farmers concerning the use of these inputs will be cleared and increase the chances of their willingness to pay. This confirms earlier studies (Gregory and Sewando, 2013and Witt et al., 2008) that, participation in demonstration trials and farmer field schools facilitate the diffusion of knowledge and information about new agricultural technologies from participant to non-participant farmers, resulting in their wide diffusion and adoption. This can be linked to the fact that misconceptions and would be risk associated with the use of new technologies are removed since farmer field schools help farmers get knowledge and firsthand experience with the technology

Years of experience in soya production: The significant level of 1% and 5% obtained for this variable implies that people who have grown soya beans for some years might have encountered or observed some factors on growth and yield. These farmers will appreciate the need for such agro inputs in their production and will be more willing to pay to accrue the benefits.

Distance to the nearest agro input dealer: This has a significant relation or influence on farmers' production decisions and willingness to pay for agro inputs for their crop production activities. Studies by Olwande and Mathenge (2010) and Ariga and Jayne (2006), show that distance to the nearest agro input market or dealer and poor road network increases transaction and transport cost of acquiring farm inputs which can limit their usage. Therefore, having accessible agro input market in close proximity, increases farmers willingness to pay for the inputs and the adoption of agricultural technologies.

Farmer group membership: Farmers, who are in groups meet on regular basis, visit each other's farms and share their experiences in production. In such cases farmer to famer extension will be amplified and farmers will adopt the agro inputs that are being applied by their colleagues to improve yield. An added advantage of group membership is access to credit where most of the financial institutions adhere to group guarantors or collateralization. Lack of collateral security has been found to hinder farmers' in accessing financial support in most cases. Adoption of soya bean inputs by any of the members will influence the willingness to pay by others once they observe the influence on performance of the crops is significant. Isham (2002) posited that farmers in a social system easily share information among themselves and hasten the rate of new technology adoption. Degnet and Mekibib (2013) found that membership to farmer cooperatives has a strong positive effect on adoption of chemical fertilizers as well.

Access to agricultural extension: Traditionally, farmers' source of agro information is from agricultural extension offices or officers. In situations where there is existence of good linkage between extension and farmers any recommended agro input from extension agent is regarded as credible and good. In consonance, Yu and Nin-Pratt (2014) studying fertilizer adoption in Ethiopia's cereal production found extension services among other factors to influence fertilizer adoption. But negative relation means that where farmers have doubt in the service delivery in terms of quality of agro information and frequency of agents visit will lead to mistrust. Many authors have attributed this to some factors. For instance Chirwa, (2005) reported that extension delivery in recent years is confronted with both financial and human resource constraints thus low extension agent farmer ratio makes the system ineffective.

Purpose of soya bean production: The reason for which one goes into crop production affects his or her decision to pay for the associated inputs. Farmers who cultivate soya bean for consumption would be satisfied with whatever yield they obtain as against those who grow for commercial purposes. The commercial producers are more profit oriented and are in the position to invest to realize high net returns. As such, commercial soya bean producers will be more willing to pay for agro inputs.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0: Introduction

This chapter presents summary of main findings of the study and draws conclusions from the results. From the major findings, recommendations are made to inform policy formulation and future studies in the area of agro inputs production and distribution to enhance productivity of smallholder famers.

5.1 Summary of key findings

This study was conducted with the objective to determine whether farmers' in Northern Ghana are willing to pay for agro-inputs for soya bean production when they are made available. Both primary and secondary data were collected for these purposes. The primary data were collected from 400 sampled soya bean farmers from three regions in northern Ghana. Descriptive and inferential statistics such as ordered Logit and Tobit models were used to identify and analyse the factors that determine farmers' WTP for agro inputs.

The prevailing market prices of the agro inputs were identified and used as bid prices for the study. They were 4, 15, 20 and 120 Ghana Cedis for certified seeds, Glyphosate, inoculants and TSP fertilizers respectively. The socio-demographic characteristics of respondents were included in the survey to obtain relevant information on soya bean producers in the study area. It was found that age in the study ranged between 16 - 81years, with a mean age of 42, implying that majority of soya bean producers are above the youth age bracket of 15 – 35years. The results also show that 57.5% of the respondents did not have any formal education, 24.5% had basic education, 12.5%

secondary and 5.5% tertiary education. This means that more than halve (57.5%) of the respondents had no formal education, and that illiteracy is high in the study area. The findings also reveal that 88.7% of the respondents were married, 8.5% single, 0.75% divorced and 2% widowed. The average household size found among respondents was nine (9) people, with a maximum of 25 and a minimum of one person.

The results show that 57.75% of the respondents generate income from both on and off-farm sources whilst 42.25% are engaged in only farming for their livelihood. All the respondents interviewed cultivate soya bean for cash income (100%), with only 5.75% for food and 1.50% for seed. The findings indicated that most respondents (73.5%) were aware of certified soya bean varieties whereas only a few (21.75%) were aware of insecticide use in soya bean production. Fifty eight and half per cent (58.5%), 46.5%, 46.75% were respectively aware of fertilizer, inoculants and herbicide usage for soya bean production. The result showing the inputs applied in the 2015 cropping season indicated that 95.3% used their own seed, while 45.5%, 29.0%, 35.5% and 46.8% used certified seed, inoculants, and fertilizers respectively . It was found that a larger number of the respondents normally obtain information on soya bean production fertilizers from MoFA (20.75%), certified seeds 21.75% and inoculants 15% of them from NGOs/Development agencies and herbicides 37% from agro input dealers. The study revealed that 67% of the respondents have participated in soya demonstration farms and have learnt something about soya bean inputs.

It was also revealed that the three most critical challenges of soya bean producers other than financial identified through ranking were drought/rain failure (42.0%), difficulty in harvesting and threshing (37.5%) and difficulty obtaining tractor services (25%) for ploughing at the right time.

Soya bean production at the study area which is most popular area for cultivating soya bean in Ghana was found to be profitable with a benefit cost ratio of 0.76

The study also revealed that, the total variable cost (TVC) of producing soya bean in northern Ghana stands at an average of GH¢340/acre with an average gross income (GI) of GH¢600, and a gross margin (GM) of GH¢260/acre. Labour was the most used input in soya bean production and accounted for 71.8% of the TVC. The income accrued from soya bean production was observed to be profitable in the area.

It was discovered that, 74% of the respondents were willing to pay for agro inputs with only 26% not willing to pay for the inputs. On account of their willingness to pay at the bid prices of the inputs it was found that 43%, 47.3%, 39.5% and 49.5% were willing to pay for certified seeds, herbicides, TSP and inoculants respectively. The major reason cited by those respondents who did not want to pay for the inputs was high prices. This reason accounted for 53%, 67%, 82.6% and 86.8% of those who did not want to pay for certified seed, herbicides, TSP and inoculants respectively.

Analyses of the factors that influence farmers willingness to pay for agro inputs was determined using ordered Logit regression with ten (10) independent variables which include age, household size, access to credit, access to agricultural extension, farmer group membership, participation in soya bean demonstrations, gains made in soya bean demonstration field schools, distance to the nearest agro input dealer and farmers' years of experience in soya beans production. The ten variables were significant for some of the inputs. Household size, participation in soya bean demonstration and lessons learnt in soya bean demonstration field days were 1% significant while access to credit was significant at 10% level.

5.2:Conclusion

Gross margin in this study was used as a proxy for profitability of soya bean production, and the results show that soya bean production in northern Ghana is profitable, as 76% will be yielded from every one Ghana cedi invested.

The high awareness and interest in the use of new inputs such as certified seed, TSP, inoculants and herbicides among respondents was due to their previous participation in soya bean field demonstration and application of similar inputs such as certified seeds, fertilizers and herbicides to crops like maize and rice. The high willingness to pay response observed in the study is also linked to farmers' participation in soya bean demonstrations involving the inputs and their influences on yield.

Respondents' high willingness to pay for soya inputs but low response at the bid prices implies that they see the prices to be too high and prefer prices lower than presented because of their generally low living standards.

The major challenge facing soya bean farmers was drought or rainfall failure followed by difficulties in harvesting and threshing, access to tractor services, non-availability of labour resulting from youth urban migration and high cost of soya inputs among others.

5.3: Recommendations

The analysis of factors influencing farmers' willingness to pay for soya bean inputs indicated the significance of farmers' participation in soya bean field demonstrations and knowledge gains from these demonstrations. It is therefore recommended that development initiatives and N2Africa and its partners in particular extend soya bean field demonstrations to other soya bean production areas in the country for farmers to have first-hand knowledge on soya bean inputs to enhance their adoption and the willingness to pay for them.

Emerging from the fact that farmers were willing to pay but not at the bid prices, suggests the need for the government to subsidize soya bean inputs to boost production as done for some grains and cereals.

Farmer group membership was found to be a significant determinant of willingness to pay for soya inputs. It is therefore recommended that MoFA promote the formation of more FBOs to enhance information sharing among farmers' especially on soya inputs, facilitate the ease of access to agricultural extension and credit to purchase soya inputs as well as tractors and threshers where group members collateralize for each other and render services for fees.

It is recommended that IITA (N2Africa) and its partners especially Savanna Agricultural Research Institute (SARI and Crop Research) to promote early maturing and drought tolerant soya bean varieties to cope with the changing climatic conditions challenging farmers.

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APPENDIX

Appendix 1 : Survey Questionnaire

Questionnaire No. ....

Willingness to Pay for Agro Inputs: The Case of SoyaBean Farmers in Northern Ghana

Name enumerator: ……………………………………………… Date………………………...

Region: ……………….. District:……..………..……Community: ……………….…………….

Name of respondent:…………………………….Mobile # (if any) -------------------

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I. HOUSEHOLD AND LAND PARTICULARS

1. Sex: please tick
   1. Female [ ]
   2. Male [ ]
2. How old are you?..................(years)
3. Educational status:
   1. Basic
   2. Second Cycle
   3. Tertiary
   4. None
4. Family particulars:

   a. Household size? …………….
5. How many members of your household are less than 14 years of age?...............................
6. How many members in the family are engaged in farming? ………..
7. Is anyone in your family working off-farm?
   1. Yes

2. No

8. If Yes to Q 7; Please specify the major sources of **Off Farm Income** for the household:
    1. Off-farm employment income (activities……………………………………………

Household Income

Annual Income

Crop	Qtyharv.	Sold	Consumed	Gift	Unit Price	Total
Maize						
Soya bean						
Yam						
Rice						
Sorghum						
Millet						
Groundnut						
Cowpea						
Cassava						
Livestock						
Cattle						
Sheep						
Goats						
Pigs						
Poultry						
Fowl						
Guinea fowl						
Turkey						
Duck						

Others	Amount Earn (GH¢)
Remittance	
Trade	
Salary	

9. What is the total arable land area you have access to?
    1. Number[…….]
    [redacted] Unit type […….]
10. From this total land, how many acres did you cultivate in last season?
    1. Number[……]
    2. Unit type […….]
11. In the current season, which of the following crops did you cultivate?

Interviewer: Multiple answers are acceptable, tick all that are applicable for the current season only

1. Soya bean
2. Maize
3. Groundnuts
4. Sesame
5. Sorghum
6. Cassava
7. Pigeon peas
8. Cowpea
9. Rice
10. Millet
11. Yam
12. Vegetables
13. Fruit
14. Tabacco
15. Other 1, ………………………
16. Other 2, ………………………
17. Other 3,………………..

If Question 11 is NOT 2

NOTE: PLEASE REFER TO ALL [SOYA BEAN] RELATED QUESTIONS TO THE [PREVIOUS], NOT [CURRENT] SEASON

Interviewer please confirm if the following questions apply to the [current] or [previous] season

1. Current
2. Previous
3. Not applicable → go to Q34

12. How many Soya bean fields did you cultivate in the [current] or [previous] season?..
13. What do you cultivate soya bean for?
    1. Seed
    2. Food/consumption
    3. Cash /Sale

14. Have you participated in any farm demonstration on soya bean?
    1. Yes
    2. No
15. If Yes, facilitated by main project/person/firm, named,……………………
16. What were some the things involved or lessons learnt?.. ....

II. SOYAMAIN FIELD RELATED QUESTIONS

NOTE: THE FOLLOWING QUESTIONS REFER TO THE CURRENTMAIN SOYABEANFIELD CULTIVATED

What is the size of your current season' MAIN soya bean field ?

1. Number […...]
2. Unittype[…….]

17. Did you intercrop your main soyabean field?
    1. Yes
    2. No
18. Do you know the variety of soyabean you planted?
    1. Yes
    2. No
19. If yes, name …………………..
20. Planting date

1. Day……………………..
2. Month……………….
3. Year,…………………

21. What is the **source**ofseed of the soyabean you planted?

1. Own seeds
2. Agro-dealer, name……………
3. Through a contract growing arrangement, name……………………..
4. Other farmer………………………………………………………..
5. Local Market,…………………
6. NGO, name……………………
7. MoFA……………………..
8. Private seed company, name………………….
9. Relatives………………………………………
10. Voucher programme……………………………..
11. Farmers' association, name…………………………
12. Other, name………………..

22. Quantity of soya bean seeds planted on the main field,…………………………..(Kg)
23. How many soya bean seeds per hole did you plant on your main field,………………… (Number.)
24. What is the spacing adopted for soya bean in your main field? ----------------------- (cm)

1. Between rows,…………….(cm)
2. Within rows,………………(cm)
3. Broadcasting

25. Did you practice thinning?

1. Yes
2. No

26. What practice did you use for land preparation?

1. Tractor
2. Animal
3. By Hand/Hoe

27. How many times did you weed your current main soya bean field?

Weeded ……..(Number) times

28. **Give names** and **sources** of agro-inputs used in on your main soya bean field in the **current** or previous season as shown in the table below;

Input name	**Name (s)**	**Sources**
Inoculant		
Greenmanure		
Animal manure		
Fertilizer		
Pesticide		
Herbicide		
Irrigation		
Other 1		

29. Interviewer: Confirm if soya crop is still in the field or already harvested
    1. In the field
    2. Already harvested
30. Can you tell us the number of bags you expect to harvest at this stage of the soya crop?
    1. Total Kg of soya:……………. (Kg) Number of bags [………] Bag size [………]
    2. Don't know / No answer
31. Can you tell us the number of bags you expected to harvest at the time of planting the soya bean crop?
    1. Total Kg of soya:……. (Kg) Number of bags [……..] Bag size [………]
    2. Don't know / No answer
32. If the bags you expect to harvest nowareless or more than the number you expected to harvest at planting stage; can you briefly indicate the reasons you think have caused this?

Reasons as in verbatim comments

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

33. How would you classify your yield performance at this stage of the soya crop?

1. High
2. Medium
3. Low
4. Crop failure

34. Did you apply fertilizers on this particular main field in the previous season?
    1. Yes
    2. No
35. If yes, for which crop…………………………….
36. What is the distance to the nearest agro inputs market?............(km)

Farmer awareness of agro inputs/ technologies in soya bean production

37. Indicate in the table below the types of agro inputs for soya bean that you know

Type of agro inputs or technologies	Sources of the technology

III. FARMER PERCEPTIONS ON INPUT USE

Note: The questions in this section relate to the **farmers' soya bean crop in general**, not restricted to the current season and main field of soya anymore.

38. In general, which3 most important agro inputs in your opinion can increase soya yields in your fields?
39.

Input name	Rank
Improved seeds	
Inoculants	
Manure	
Fertilizer	
Pesticide	
Herbicide	
Other 1,…………..	

Perception on Improved Seed Use

40. Where do you get yourseed for planting from?
41. How many different varieties of soyabeanhave you used in the last 3 years?

    Number of soyabean varieties used in last 3 years [……..]

42. Please name the soyabean varieties you have used in the last 3 years?
    1. Variety name 1 [………………..]
    2. Variety name 2 [………………..]
    3. Variety name 3 [………………..]
    4. Variety name 4 [………………..]
43. Which is your most preferredsoyabean variety?

    Variety name [………………..]

44. Are you planning to grow soyabean in the next season?
    1. Yes
    2. No
45. If yes, how many acres/ha……..
    1. Number [……]
    2. Unit type […….]
46. Will you grow your most preferred soyabean variety […………] in the next growing season?
    1. Yes

2. No

If no to Q 45 please ask

47. Why will you not grow your preferredsoyabean variety in the next growing season?

Reasons as in verbatim

comments……………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
…………

If yes to Q45, please ask

48. How many kg of your preferred soyabean seeds would you like to buy for the next cropping season at a price of [GHS 4.00] per kg?........
49. If No, why………………………………………………………………………..….

If reason for not buying is price related

50. What price are you willing to pay for your preferredsoyabean seed?
    1. Price willing to pay per kg [………]
51. In that case, at that preferred price how many **kg** will you buy?
    1. And will buy [………] kg in that case
52. Where would you prefer to buy your favorite soya bean variety?
    1. Name of preferred buying point/entity…………………..

53. Where did you sell your last season soyabeanproduce?...
    1. Sold to,………………………………………………………………..
    2. Not applicable

54. Where areyou likely to sell your soyabean produce this season?.......................................

3. Sellto,……………
4. Not applicable

Perception on Fertilizer Use

55. Did you use fertilizer for soya beanproduction in last 3 years?

1. Yes
2. No

56. How many different types of fertilizers have you used for soya bean in the last 3 years?……………………………………………………………………….

57. Please name the fertilizer types you have used for soya bean production in the last 3 years?

1. Fertilizer name 1 [………………..]
2. Fertilizer name 2 [………………..]
3. Fertilizer name 3 [………………..]

58. Are you planning to apply fertilizer for soyabean in the next season?

1. Yes
2. No

59. If yes, how many acres/ha…………………………………………………

1. Number […….]
2. Unit type […….]

If no to Q 57, please ask

60. Why would you not apply fertilizer for soyabean in the next growing season?

Reasons as in verbatim

comments………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

Fertilizer 1: TSP (Triple Superphosphate)

If yes to Q57, please ask

61. For **soyabean** only; how many kg of TSP would you like to buy for the next cropping season at a price of [120 GHS] per 50 kg?.........
62. If no, why……………………………………………………………………………… ..

If reason for not buying is price related

63. Interviewer, is the reason for not buying price related
    1. Yes
    2. No
64. What price are you willing to pay for TSP?
    1. Price willing to pay for TSP per 50 kg bag [………]
65. In that case, at that preferred price how many bags of TSP will you buy?
    1. And will buy [………] bags of TSP in that case
66. Where are you likely to buy TSP?
    1. Agro-dealer
    2. Through a contract growing arrangement
    3. Local Market
    4. NGO
    5. MoFA
    6. Farmer Association (name……………………………………........................)

Fertilizer 2: NPK (Nitrogen; Phosphorus &Potassium)

If yes to Q57, please ask

67. For **soyabean** only; how many kg of NPK would you like to buy for the next cropping season at a price of [140GHS] per 50 kg?
    1. Bags of NPK the respondent likes to buy and apply for soya only [….]
    2. I will not buy

68. If no, why………………………..

If reason for not buying is price related

69. Interviewer, is the reason for not buying price related
    1. Yes
    2. No
70. What price are you willing to pay for TSP?
    1. Price willing to pay for TSP per 50 kg bag [………]
71. In that case, at that preferred price how many bags of TSP will you buy?
    1. And will buy [………] bags of TSP in that case
    2.
72. Where are you likely to buy TSP?
    1. Agro-dealer
    2. Through a contract growing arrangement
    3. Local Market
    4. NGO(name……………………………………………….)
    5. MoFA
    6. Voucher programme
    7. Farmer Association (name……………………………………….)

Perception on Herbicide Use

73. How many different types of HERBICIDES have you used for soyabean in the last 3 years?

    Number of HERBICIDES used in last 3 years [……..]

74. Please name the HERBICIDES types you have used for soyabean in the last 3 years?
    1. HERBICIDES 1 [………………..]
    2. HERBICIDES 2 [………………..]
75. Are you planning to apply HERBICIDES for soyabean in the next season 2016?

1. Yes,
2. No

76. If yes, for how many acres/ha………..

1. Number [……]
2. Unit type […….]

If no to Q74 please ask

77. Why will you not apply HERBICIDES for soyabean in the next growing season?

Reasons as in verbatim

comments………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………

Herbicide 1: GLYPHOSATE (2-4D)

If yes to Q74please ask

78. For soyabean, how many litres of GLYPHOSATE (2-4D) would you like to buy for the next cropping season at a price of [15 GHS] per litre? ………

1. Number of litres of GLYPHOSATE (2-4D)the respondent likes to buy and apply for soya only [….]
2. I will not buy

79. If no,

Why………………………………………………………………………………….

….

If reason for not buying is price related

80. **Interviewer**, is the reason for not buying price related

1. Yes
2. No

81. What price are you willing to pay for GLYPHOSATE (2-4D)?

1. Price willing to pay for GLYPHOSATE (2-4D) per liter [………]

82. At that preferred price how many liters of GLYPHOSATE (2-4D) will you buy?
    1. And will buy [………] bags of TSP in that case
83. Where are you likely to buy GLYPHOSATE (2-4D)?
    1. Agro-dealer
    2. Through a contract growing arrangement
    3. Local Market
    4. NGO
    5. MoFA
    6. Voucher programme
    7. Farmer Association (name…………………………………………………….

Perception on Inoculant Use

84. How many years have you been growing soyabean [……..]
85. For **soya bean**only; how many 100 gram packages of inoculants would you like to buy for the next cropping season at a price of [20 GHS] per 100 gram package?
    1. Packages of inoculants willing to buy and apply for soya only [….]
    2. I will not buy
86. If no, why……………………………………………………………………………...

If reason for not buying is price related

87. Interviewer, is the reason for not buying price related
    1. Yes
    2. No
88. What price are you willing to pay for Inoculants?
    1. Price willing to pay for Inoculants per 100 gram package [………]
89. At that preferred price, how many packages of Inoculants will you buy?
    1. And will buy [………] packages of Inoculants in that case

General Challenges of farmers in soya bean production apart fromfinance

Indicate in the table below the challenges face in the soya bean production

Challenges	Adaptation strategies	Ranks

Please indicate your access to the following

Extension[1] Yes [2] No

Number of contacts this season

Credit [1] Yes [2] No

Please source……………….

Do you belong to any farmer group? [1] Yes [No]

Thank you.