THE COMPETITIVENESS OF SOYBEAN PRODUCTION IN THE UPPER WEST REGION OF GHANA

BY

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DECLARATION

I, Moses Dumayiri, the author of this thesis, titled: "The Competitiveness of Soybean Production in the Upper West Region of Ghana" do hereby declare that, with the exception of references duly cited, this thesis is entirely done by me, under the supervision of Prof. Wayo. A. Seini and Mr. D. P. K Amegashie in the Department of Agricultural Economics and Agribusiness, University of Ghana, Legon from August, 2011 to July, 2012 and further declare that, this thesis has never been submitted in part or in whole for any other degree in this University or elsewhere.

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This thesis has been presented for examination with our approval as supervisors.

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DEDICATION

This thesis is dedicated to the Almighty God whose grace gives me enormous strength every day to complete this work. It is also, dedicated to my parents and guardians for their support and guidance which have made this work possible.

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LIST OF ACRONYMS AND ABBREVIATIONS

ADRA	Adventist Relief Agency
AAGDS	Accelerated Agricultural Growth and Development Strategy
ADB	Agricultural Development Bank
BFP	Block Farm Programme
CCAA	Competitive Commercial Agricultural in Africa
CSIR	Council for Scientific and Industrial Research
CRI	Crop Research Institute
DRC	Domestic Research Cost
EPC	Effective Protection Coefficient
FAO	Food and Agricultural Organization
FAOSTATS	Food and Agriculture Organization Statistics
FRI	Food Research Institute
FCDP	Food Crop Development Project
FASDEP	Food and Agricultural Sector Development Policy
GDP	Gross Domestic Product
GPRS	Growth and Poverty Reduction Strategy
GSS	Ghana Statistical Service
HIPC	Highly Indebted Poor Country
IITA	International Institute for Tropical Agriculture
ISSER	Institute of Statistical, Social and Economic Research
INTSOY	International Soybean Programme
MoFA	Ministry of Food and Agriculture
MOTI	Ministry of Trade and Industry
MOFEP	Ministry of Finance and Economic Planning

NGO	Non-Governmental Organization
NARS	National Agricultural Research System
NPCI	Nominal Protection Coefficient on Input
NPCO	Nominal Protection Coefficient on Output
KNUST	Kwame Nkrumah University of Science and Technology
OECD	Organization of Economic Co-operation and Development
PAM	Policy Analysis Matrix
PASW	Predictive Analytic Soft Ware
PCR	Private Cost Ratio
PHC	Population and Housing Census
RCR	Revealed Comparative Advantage
SSA	Sub-Sahara Africa
SARI	Savannah Agricultural Research Institute
UG	University of Ghana
USA	United States of America
USAID	United States Aid for International Development
UST	University of Science and Technology
UWR	Upper West Region
WA	West Africa
WFP	World Food Programme
WISHH	World Initiative for Soy in Human Health

ABSTRACT

In Ghana, soybean production has received considerable promotion since its introduction in 1910 ranging from research, education on utilization technologies, subsidies, etc. The government still provides subsidy to soybean production in the form of soft credit on inputs (fertilizer, seeds, ploughing). Despite these support systems, little or no study has been conducted to assess the private incentives for farmers to continue its production and the sustainability of its production if the support systems are withdrawn. An equally important related issue that has not also received research attention concerns the extent to which social profit deviates from its private counterpart as well as the constraints to soybean production as it pertains to the Upper West Region of Ghana. This study sets out to assess the competitiveness of soybean production in the Upper West Region, and applied the policy analysis matrix (PAM) approach. The results indicate that soybean production in the Upper West Region is privately profitable. This means that farmers have the incentive to continue growing the crop. However, with regards to efficiency the results show that soybean production in the Upper West Region exhibits lack of economic efficiency in the use of scarce domestic resources as demonstrated by a negative social profit and a Domestic Resource Cost (DRC) ratio of greater than unity. The finding suggests that the soybean industry in the Upper West Region will not be sustainable in the absence of government's support. Based on these results, the study recommends that government should continue to provide subsidies to inputs. The subsidy on fertilizer in particular, should be extended to include the development and dissemination of the new seed variety (Jenguma) developed by SARI at a subsidised price to serve as incentives for farmers to grow the crop. The government should take proactive measures to provide irrigation facilities to solve the constraint of over reliance on rainfall.

CHAPTER ONE

INTRODUCTION

1.1 Background

According to FAO (2005) consistent improvements in average yield levels and reductions in production costs have steadily improved the competitive position of soybeans among arable crops. Among oil crops, soybean covers a leading role at the global scale. Currently, soybeans account for about 35% of total harvested area devoted to annual and perennial oil crops. The crop's share in global oil crop output is estimated at 44%. Cultivation is highly concentrated geographically with only four countries - USA, Brazil, Argentina and China - accounting for almost 90% of world output. Asia- excluding China and Africa, together account for only 5% of world production. In Africa, Nigeria is the leading producer of soybean with an average of 0.4 million tons between 2000-2003 periods (FAOSTAT, 2004). Goldsmith (2008) indicates that Soybean production occupies close to 6% of world arable land and its expansion is occurring much faster than major grains or oils.

As one of the world main crops, soybean contributes significantly to overall human nutrition in terms of both calorie and protein intake; the is well placed to meet the fast growing demand for vegetable oil and animal feed in developing countries. Soybean production should be encouraged in smallholder based production systems in the tropics and subtropics to diversify production, raise income levels, and capture positive rotation effects that improve productivity of other crops being grown. However, economic viability depends critically on the availability of local marketing opportunities. Global soybean production, processing and marketing is characterized

by a high level of concentration, specialization, vertical integration and economies of scale, so that small producers in developing countries find it very difficult to compete, especially when confronted with fast expanding and highly efficient trade (FAO, 2005).

Soybean is a relatively new crop in Africa. Until recently, it was seen as being appropriate only for large-scale commercial farming where the crop can be used for industrial processing and for livestock feed (Shannon et al, 1995). A commonly held view is therefore that soybean is of little or no importance in sub-Sahara Africa, since the crop will not bring benefit to small scale farmers who form the majority of the farming community (Sanginga et al., 1999).

According to Plahar (2006) soybean was introduced in Ghana in 1910 and was used by farmers in the northern sector in communities such as Bimbila, Nakpanduri, Karaga, Tilli, and Bawku, in their traditional foods. However, the main problem farmers encountered in this experimental stage was the loss of seed viability in storage. Through the late 1960s and early 1970s, soybean research was intensified by Centre for Scientific and Industrial Research (CSIR)-Crop Research Institute and the University of Ghana's Agriculture Research Station aimed at improving human and animal nutrition. These attempts also failed due to poor knowledge of soy utilization at household level, weak industrial base for soy processing, unattractive production package to farmers and lack of market for the crop.

In 1975 and 1977, major soybean campaign was launched in support of the growing poultry industry in the country. At this time, farmer response was positive and this

resulted in a remarkable increase in production. However, the utilization base was low and knowledge of processing was still inadequate. In the late 1980s and 90s, public private partnership approach was adopted to launch a massive campaign on soybean production and utilization under Ministry of Food and Agriculture. This period also witnessed the formation of an inter-sectoral national committee on soybean production and utilization. This committee was made up of MoFA, CSIR agricultural based institutes, Universities, Food Distribution Corporations, farmers and industries. Emphasis was also placed on policy formulation, planning, monitoring and evaluation of soybean production, marketing and utilization in Ghana. During this period, soybean received massive promotion. The promotion derive was focused on Simultaneous promotion of production and utilization, Production of oil for human and cake by-product for animal feed, Promotion of household utilization technologies. A number of NGOs such as ADRA and Plan Ghana also promoted soybean production and utilization in Ghana.

MOFA and NARS have been involved in adaptive research, proper agronomic practices and varietal improvement programmes. Nyankpala agricultural research station of the CSIR-CRI, have carried out some varietal trials in collaboration with the International Soybean Programme (INTSOY) of the University of Illinois. Later joined by Grains and Legumes Development Board, Ghana/CIDA Grains Development Project of CRI, University of Ghana research station, Kpong and UST.

Currently, it is promoted under the MOFA Crops Development Project (soybean committee). This committee is made up of Research and Development institutions (CSIR-CRI, FRI and SARI, and KNUST-Technology Consultancy Centre (TCC) and

MoFA-Agricultural Engineering Services Department), producers (Farmers' Group Representatives, Seed Growers Association, Grain and Legumes Development Board).

More recently, soybean production is being supported under the government block farm and the youth in agriculture programmes. Under the block farm programme, farmers are given interest free credit to production inputs (fertilizer, seed and tractor services) during the planting season and they are expected to pay back either in cash or in kind after harvesting (MoFA, 2010). Apart from this, soybean farmers also benefit from the fertilizer subsidy programme implemented by the Ministry of Food and Agriculture just as their other counterpart farmers (MoFA, 2011). Under the fertilizer subsidy programme, government subsidized the prices of the following fertilizers up to the tune of almost 50% on the average for the 2011 farming season (Table 1.1).

Table 1.1: Actual and subsidized prices of fertilizers for 2011 farming season

Fertilizer type	**Weight (kg)**	**Price (GH¢)**	
		Actual market	Subsidized
NPK (15: 15: 15)	50	56	30
NPK (23: 10: 05)	50	56	30
Sulphate of Ammonia	50	40	25
Urea	50	51	29
Sulfan	50	50	25

Source: MoFA, UWRADU, 2011

Current production of soybean in Ghana is still concentrated in the northern part of the country with a mean acreage under soybean cultivation per farm of 3.4 acres.

Production in southern Ghana is still at rudimentary stages except a few satellite farms and Ejura farms that cultivate 300 acres (Plahar, 2006).

The growing demand for soybean is attributed to the growth of the poultry industry and increased industrial processing operations. An efficient and competitive soybean production system with its backward and forward linkages holds the key to unlocking the huge potentials in the growing poultry industry and agro-processing establishments in Ghana. Currently, Ghana is a host to over 1,372 poultry operations (Aning, 2006); and over 23 soybean processing companies (Plahar, 2006). The Low competitiveness of the Ghanaian poultry industry leading to increased poultry imports reaching 66,899 tons in 2007 from 9,110 tons in 2000 (FAOSTATS, 2007) has been attributed to high feed cost. In Zambia, Keyser (2007) indicates that opportunities in the soybean sector depend largely on continued growth in domestic poultry production. This is why the growth of the poultry industry is critical to the success of soybeans.

The rising demand for soybeans input for industrial processing into oil and soybean meal for both human and livestock consumption, has exceeded local supplies thus compelling government to import in order to augment domestic supply to meet the growing gap between demand and supply. Loosevelt (2010), indicate that in the year 2007, Ghana Nuts LTD; the main soybean processing company in the country could not access soybean in the Ghanaian market and was compelled to import the commodity for its processing operations. The import level of soybean in Ghana rose from two (2) metric tons in 2001 to an all time high record level of 4,400 metric tons

in 2008 (FAOSTATS, 2010; MOTI, 2010). Over the same period, the annual average from the three main producing areas in Ghana (Upper West, Upper East, and Northern Regions) together accounted for 44,600 metric tons (FAO, 2010).

In Upper West Region of Ghana, which is the main focus of this study, ADRA and Upper West Agro-Industry Ltd are other major players in the soybean industry aside from government that have supported soybean production. The former provided production inputs (seed, fertilizer, ploughing, herbicides and even food) to soybean farmers during the production season while farmers were expected to provide the other cultural practices. At the time of harvesting, farmers were also expected to pay back the soybean equivalent of the credit provided whilst the remainder produce goes to the farmer. The latter (Upper West Agro-Industry Ltd) supports out grower farmers with credit in the form of seeds, fertilizer, tractor services, and other production inputs and the farmers were expected to sell their produce to the company to feed its oil processing plant at Sombo after harvesting. Even though, these production arrangements have their own limitations it is not the focus of this study. However, these organisations together have increased farmers awareness about the importance of soybean and this has resulted in a remarkable increase in the levels of production of the crop from 8,806 metric tons in 2005 to 21,219 metric tons in 2010 (MoFA, 2011) as shown in Table 1.2

From Table 1.2, Wa Municipal, Wa West, Wa East, and Nadowli are the major soybean producing districts in the Upper West Region. While Lawra, Jirapa-Lambussie, Sissala East and Sissala West are the least soybean producing districts in

the region. Therefore, any effort to boost soybean production in the region should take into consideration this basic fact.

Table 1.2: Levels of Soybean Production in Upper West Region (in metric tons).

Districts	Year					
	2005	**2006**	**2007**	**2008**	**2009**	**2010**
Wa West	2,270	3674.46	3,439	3,525	5,090	6,800
Wa East	2,295	3,799.49	3,100	3,439	5,020	5,837
Wa Municipal	3,301	3,811.2	3,110	4,000	5,380	6,440
Lawra	151	155	143	147	136	173
Sissala West	129	137.75	135	145	218	290
Sissala East	137	143.04	117	126	232	304
Jirapa-Lambussie	-	-	-	199	216	616
Nadowli	523	615	633	752	576	760
Regional total	**8,806**	**12,335.94**	**10,677**	**12,804**	**16,868**	**21,219**

Source: SRID, MoFA, UWR, 2011.

Soybean production in the region can be classified in terms of land size put into cultivation and also in terms of the variety use. In the former case, farmers are categorized into micro and small scale farmers, while in the later, farmers are dichotomised into those who use the two high- yielding non-shattering new varieties (Jenguma and Quarshie) developed by Savannah Agricultural Research Institute (SARI) and the old varieties (Anedaso, sylintuah 1 and 2).

In Ghana, a number of government support systems have been given to agricultural production in general and soybean production in particular. Government facilitates farmers' access to loans through financial institutions such as the Agricultural Development Bank (ADB) (WISHH, 2006). Government also makes seeds available for interested farmers and subsidize inputs such as fertilizer to make them accessible to farmers. For instance, government subsidised 60,000 metric tonnes of fertilizer at an average cost of GH¢ 16.00 per bag, as part of efforts to increase productivity under

the fertilizer subsidy programme (MOFEP, 2011). Under the Block Farm Programme, about 47,000 hectares of land were cultivated with maize, rice, sorghum, soybean and vegetables. This programme provided financial opportunities to 80,000 beneficiaries out of whom soybean farmers are part (MOFEP, 2011; ISSER, 2011).

The MoFA Organises regional workshops and seminars on household utilization as a means of creating market for the crop. The Food Crop Development Project (FCDP) in collaboration with the Food Research Institute (FRI) has conducted a Soy bean utilization studies in the country. FCDP is supporting adaptive (agronomic) research of Soy at SARI and CDI (WISHH, 2006). FRI formulates high protein baby foods and infants' weaning foods to solve the protein energy malnutrition problem among the poor in Ghana. FRI also offer technical, analytical and consultancy services to soybean processing enterprises. FRI collaborates with international bodies and other relevant institutions on recipe and product development, quality evaluation and promotion. Government has not set barriers on soybean trade. For instance, there are no set quotas, restrictions, tariffs or incentives for the importation of Soy products/ingredients into the country (WISHH, 2006).

1.2 Problem Statement

In Ghana, Soybean production has received considerable promotion since its introduction in 1910 ranging from research, education on utilization technologies, subsidies etc (Plahar, 2006). The government still provides subsidy to soybean production in the form of soft credit to inputs (fertilizer, seeds, ploughing). In the case of fertilizer the subsidy is even up to 50% on the average (PFAG, 2010; MoFA, 2011). Currently, the Ministry of Food and Agriculture (MoFA) is promoting its

production among three other crops (rice, maize and sorghum) under the Youth in Agriculture Programme (YAP) and the government of Ghana Block Farm Programme (BFP) (MoFA, 2010; MoFEP, 2011; ISSER, 2011). Since the government budget and subsidy have been limited, efficiency and competiveness in production, marketing and trade become crucial issues. Government often intervene in agriculture and influence inputs and outputs markets (Akhtar et al., 2007; Pearson et al., 2003).

It is well known among economists that with distorted markets and trade barriers, domestic resources are costlier than traded inputs and distortions lead to the misallocation of resources (Gonzales, 1984; Gonzales et al., 1993; Akhtar et al., 2007; and Monke and Pearson, 1989). Due to these distortions in factors and output markets, externalities and government policy interventions, social or economic profitability deviates from their private counterparts (Quddus and Mustafa, 2011). This allows a wide gap between competitiveness and comparative advantage, and failure to measure and account for market distortions might lead to biases (Khan and Hussain, 2004). The divergence between private and social profit stems from the varying interest of the producers and society (Khan, 2001). On the one hand, a crop can be profitable to farmers (e.g. because of input or output subsidies), but its production may not represent efficient use of resources from the point of view of the nation. On the other hand, a crop can be unprofitable to farmers (e.g. due to taxes imposed on output or input prices), however its production may represent an efficient use of the nation's resources.

Despite years of government policy interventions in agriculture in general and soybean production in particular, little or no study has been conducted to assess the private incentives for farmers to continue its production and the sustainability of its

production if the support systems are withdrawn. An equally important related issue that has not also received research attention concerns the extent to which social profit deviates from its private counterpart as well as the constraints to soybean production as it pertains to the Upper West Region of Ghana. Studies that have been conducted in the sector tend to focus on value addition (Dzogbefia and Zakpaa, 2007); nutritional value and utilization technologies (Daaku and Mensah, 2006; Plazar, 2003, 2006; Otoo, 2008; WISHH, 2006) and overview of the industry (Plahar, 2006). The present study, therefore, addresses the following questions. Is soybean production in the Upper West Region profitable privately and socially? What are the transfer effects of government policies on soybean production in the Upper West Region? What are the constraints to soybean production in the Upper West Region?

1.3 Research Objectives

The main objective of this study is to assess the competitiveness of soybean production in the Upper West Region of Ghana. The specific objectives of the research are**:**

1. To analyse the private and social profitability of soybean production in the Upper West Region.
2. To measure the transfer effects of government policy on soybean production in the Upper West Region.
3. To identify and rank the constraints to soybean production in the Upper West Region.

1.4 Justification of the Study

The study will unravel the private and social profitability of soybean production and hence demonstrate the competitiveness and economic efficiency of the system. This informs government policy as to whether support systems are needed to serve as incentives for farmers to continue production. It also indicates whether or not the scarce resources of the state are efficiently allocated (Pearson et al., 2003). In other words, it shows whether the long term sustainability of the soybean system will be assured in the absence of policy support. The study also estimates the transfer effects of government interventions on soybean production in the Upper West Region and suggests whether or not interventions are needed to provide incentives for farmers to increase production and hence income.

It again, identifies and ranks the constraints to soybean production and proposes measures to deal with them. This study is also of immense benefit to soybean producers, processors and traders who are the ultimate beneficiaries in making their investment decisions. The research fills the literature gap and contributes to ongoing debate on competitiveness especially as it pertains to soybean production in Ghana. Therefore, this study which sets out to assess the competitiveness of soybean production in the Upper West Region of Ghana is relevant.

1.5 Organisation of the Thesis

This thesis is organised into five chapters. Chapter one presents the introduction of this study which covers the background, the problem which motivated this study, objectives, and the study's justification.

Chapter two reviews previous studies which are of relevance to this study. Literature have been reviewed on measures of competitiveness, methodological aspects of competitiveness, empirical literature on constraints to soybean production, empirical literature on private and social profitability and soybean production systems.

Chapter three presents the methodology of the study which covers the theoretical foundation, methods of analysis, empirical model and estimation procedures, statement of hypothesis, validation of hypothesis, data collection (types and sources of data, sample size and sample techniques, survey instruments, and data analysis-computer packages used), classification of farmers by size of production and an overview of the study area. Chapter Four presents and discusses the results of the study. Finally, Chapter Five summarizes the results, draws conclusions and makes policy recommendations based on the findings of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews previous studies which are of relevance to this study. Literature have been reviewed on measures of competitiveness, methodological aspects of competitiveness, empirical literature on constraints to soybean production, empirical literature on private and social profitability and soybean production systems.

2.2 Measures of Competitiveness

Competitiveness is a broad concept which has no precise definition and measurement (Latruffe, 2010). Others view competitiveness as a multidimensional concept which means differently to different people depending on the context and level (Ambastha and Momaya, 2004). There is, therefore, a profusion of definitions with studies often adopting their own definition and choosing a specific measurement method. Several authors stress that competitiveness does not have a definition in economic theory (e.g. *see* Sharples, 1990; Ahearn *et al*., 1990). The Organisation for Economic Co-operation and Development (OECD) defines competitiveness as the "ability of companies, industries, regions, nations, and supranational regions to generate, while being and remaining exposed to international competition, relatively high factor income and factor employment levels on a sustainable basis" (Hatzichronologou, 1996). The global competitiveness report 2008-2009 defines competitiveness as "the set of institutions, policies, and factors that determine the level of productivity of a country" (Porter et al., 2008). However, there seems to be consensus among researchers regarding which measures could be used to assess competitiveness.

Two disciplines exist to measure competitiveness neoclassical economics and strategic management school (Latruffe, 2010). The former focuses on trade success and measures competitiveness with the real exchange rate, comparative advantage indices and export or import indices. While the latter, places emphasis on firm's structure and strategy. In this latter case, competitiveness is defined as cost leadership and non-price supremacy, with cost competitiveness measured according to various cost indicators, as well as productivity and efficiency (Latruffe, 2010).

Some researchers (e.g. Martin, undated) have defined competitiveness in terms of micro-economic and macro-economic perspectives. At the firm, *or* micro-economic level, the notion of competitiveness is based on the capacity of firms to compete, to grow, and to be profitable. At this level, competitiveness resides in the ability of firms to consistently and profitably produce products that meet the requirements of the market in terms of price, quality, etc. Competitive firms are able to increase their market share while uncompetitive ones will find their market share decline – unless it is provided by some 'artificial' support or protection – will go out of business.

By comparison, at the macro-economic level the concept of competitiveness is much more poorly defined and more strongly contested (Martin, undated). Despite the fact that improving a nation's or region's competitiveness is frequently presented as a central goal of economic policy, arguments abound as to precisely what this means and whether it is even sensible to talk of competitiveness at a macro-economic level at all.

Competitiveness can be looked at three different but inter-related levels: firm, industry and country. Firm level competitiveness is of the greatest interest among practitioners and has attracted the maximum attention of researchers among the three levels of competitiveness (Ambastha and Momaya, 2004). Many researchers have written about the importance of firm level competitiveness. Nations can compete provided their firms can compete. It has been noted that it is the firms, not nations, which compete in international markets (Porter, 1998). The firms actually compete in the global arena and face direct competition. The environmental factors are more or less uniform for all competing firms. Research shows that thirty six percent of the variance in profitability could be attributed to the firms' characteristics and actions (McGahan, 1999).

2.2.1 Strategic Management Measures of Competitiveness

Porter (1990) was one of the first to underline the importance of firms' strategy and structure in developing their competitiveness. He is credited with the "diamond model" which states that nations succeed in industries for which the national diamond is the most favourable (Latruffe, 2010). The four corners of the diamond as cited in his work include factor conditions, demand conditions, presence of related and supporting industries, and firm' strategy, structure and rivalry. In this framework, competitiveness is revealed by performance indicators such as cost superiority, profitability, productivity, and efficiency.

2.2.2 Comparative Advantage

Trade theory suggests that a nation's competitiveness is based on the concept of comparative advantage (Ricardo, 1817). Comparative advantage postulates that trade flows are the result of differences in production costs among countries and that a country will specialise in the production of a good in which it has a cost advantage. Such a concept is useful when comparing countries, that is to say when measuring international competitiveness. Some of the measurement methods that have been used by literature to measure trade competitiveness include real exchange rate and purchasing power parities, revealed comparative advantage and derived indicators, and other export and import indices (Latruffe, 2010). Warr (1994) argued that competitiveness and comparative advantage are not the same and any attempt to portray them as being the same, or at least similar, is misleading. Comparative advantage indicates whether it is economically advantageous for a country to expand production and trade of a specific commodity, while competitiveness indicates private commercial performance of individual firms (Warr, 1994).

2.3 Methodological Aspects of Competitiveness

To be able to know whether it is profitable to produce an agricultural commodity in any part of the country requires proper analysis of the production process and marketing of that commodity (Kirsten et al., 1998). The production analysis will involve analysing critically the input requirements of the production process as well as the output that will be created. By applying social or economic analysis, it will be possible to determine whether the scarce resources of the country for agricultural production are used efficiently. In addition to this, it will also be possible to determine

whether the government's agricultural policies are correct and not leading to inefficient allocation of resources (Kirsten et al., 1998).

In a world of trade restrictions and distorted exchange rates leading to distorted prices and unrealistic investment decisions by governments, considerable effort was spent on devising frameworks which could be analytically satisfactory and practically useful for the measurement of the opportunity cost of producing or saving foreign exchange as well as for the measurement of the economic cost of various restrictive or protected systems. Among such frameworks developed was the policy analysis matrix.

To make the sources of an activity's competitiveness and economic efficiency fully explicit, Monke and Pearson (1989) devised the Policy Analysis Matrix (PAM) which is used in this analysis. However, Masters and Winter-Nelson (1995) augmented this framework to cater for recent developments in price distortion analysis. The PAM is essentially, a product of two accounting identities. The first defines "profitability" as the difference between revenues and costs. The other measures the effects of government intervention or divergences (market failures) as the difference between observed parameters and parameters that would exist if the divergences were removed (Kirsten et al., 1998). By filling the elements of the PAM for an agricultural activity, it would be possible to measure the extent of policy effects and the inherent economic efficiency and competitiveness of the activity. Most of the measures of competitiveness and comparative advantage, such as the RCR, DRC, and PCR, among others, can be calculated from the policy analysis matrix. This makes it a more comprehensive and appropriate method to use.

One of the main strengths of this approach is that it allows varying degrees of disaggregation. It also provides a straightforward analysis of policy-induced effects (Kirsten et al., 1998). Despite its strengths, the PAM approach has been criticized because of its static nature (Mohanty et al., 2003; Esmaeli, 2008). Some do not consider the results to be realistic in a dynamic setting (Nelson and Pangabean, 1991). One of the ways to overcome this limitation is to conduct sensitivity analysis under various assumptions.

The policy analysis matrix has a long history of practical use. Government planners and researchers alike applied it quite extensively in Indonesia as a policy analysis measure (Krueger, 1966; 1972, Arisudi and Gapor, 2008; Aji, 2003; Romdhon and Cahyadinata, 2004; Dipokusumo, 2003; Tarumum, 2004; Arsanti et al., 2007; Hermanto et al., 1991; Salam and Rahmadani, 2003). Then in Pakistan it has been applied extensively to assess comparative advantage and efficiency in resource use in agricultural production systems (Javed et al., 2008; Akhtar et al., 2007). Several studies that dealt with competitiveness and efficiency of agricultural production systems have also used the model broadly. For instance, Sagri, 2011; Asuming-Brempong, 1998; Appleyard, 1987; Budastra and Dipokusumo, 2003/2004; Rasmikati and Nurasiyah, 2004; Keyser, 2006; Filho et al., 2009; Jierwriyapant and Hadi, 1991; Hermanto et al., 1991; Hartadi and Msi, 2003; Unang, 2003; Waney and Tujuwale, 2002; Esmaeli, 2008; Seini and Asante, 1998, among others.

The domestic resource cost method has also been widely applied and still remains the dominant measure in comparative advantage in numerous World Bank and USAID sector studies (World Bank, 1991), as well as studies done by CYMMIT (Morris,

1990), the FAO (Appleyard, 1987), IFPRI (Gonzalez *et al.*, 1993), USAID maize production studies in Zimbabwe (Masters, 1994), cotton production studies in Georgia, USA (Shurley, 1992), comparative advantage and commercial wheat production in South Africa (Kirsten et al., 1998) and others. This method is, however, limited when it comes to analysing private and social profitability of agricultural production systems and evaluating divergences between market and efficiency prices of commodities caused by distorting government policies and market failures (Monke and Pearson, 1989). This limitation has to do with valuing inputs and outputs, particularly when choosing the appropriate opportunity cost of non-traded primary factors such as land, labour, capital and water, especially when no market for such factors exists. Similarly, prices of tradables often do not correspond to their true economic value because market imperfections and government intervention to control prices and ration the distribution of goods result in distorted prices (Rashid and Hamid, 1995).

The PAM has its own limitations. For example, the model is a static one (Pangabean, 1991) because its enterprise budgets are usually constructed for a base year and hence does not take into account changes in major parameters such as the exchange rates, yield of crops, rates of use of inputs, social and private prices of inputs and outputs, among others. However, sensitivity analysis is conducted to determine whether the competitiveness and comparative advantage indicators are sensitive to changes in individual parameters.

2.4 Empirical Literature on Constraints to Soybean Production

Moradeyo et al. (2010) investigate the constraints and determinants of technical efficiency in medium-scale soybean production in Benue State of Nigeria. Their results indicate that the major constraints on soybean production as perceived by medium-scale farmers, among others, were inadequate processing facilities and lack of mechanical services. The study concludes that Nigeria public and private policies that would improve the farmers' experiences in soybean production especially in handling the available technologies would lead to significant increase in the level of technical efficiency in medium-scale soybean production.

Also, Kahair et al., (2003) examine the production constraints of soybean in upland Balochistan. Their survey classified the common general constraints to soybean cultivation into three socio-economic, technical and institutional constraints. Their findings indicate that major socio-economic constraints were crop disposal at reasonable price and shortage of capital. Major technical constraints causing low yield were water stress and less information about soybean agronomic practices, while the institutional constraints were lack of monitoring and lack of extension campaign about the crop.

Arisudi and Gapor (2008) in their study of the competitiveness of soybean production in Blitar-East Java of Indonesia attributed the productivity of the crop to low technical practice, low technology transformation and agricultural management that has less orientation to business. FAO (2005) identified access to local market as the major constraint in many developing countries in the tropics and sub-tropics where soybean production has the potential to improve farmer incomes and the sustainability of the

production system. Again pest infestation was found to be a major constraint in increasing production in the intensive soybean crop in Ha-bac, Ha-noi-binch, and Vinh-phu. Bean fly (meanagromyza sojae) destroyed 30% to 80% of soybean plants (Quang-Hanh, Phuong, and Guyen, undated).

Olomola (2007), in his study of the Competitive Commercial Agriculture in Africa (CCAA), Nigeria, identified ignorance of improved production methods among farmers, inadequate supply of modern inputs, low output price, inaccessible of credit facilities to majority of the farmers and poor storage facilities as the major constraints to higher soybean production and utilization in Nigeria.

FAO (2003) indicates that in many developing countries in the tropics and sub-tropics, access to local market is a major constraint to soybean production. In Ghana, there has been an increased interest in soybean production for the past decade as a result of government's policy to encourage its development, production and utilization in the country, within the framework of the Medium Term Agricultural Development Programme. However, factors such as low plant stand, erratic and unpredictable rainfall (often leading to periods of drought) and insect pests have limited increased productivity (Dapaah et al., 2005). Plahar (2006), in his overview of the soybean industry in Ghana, cited poor knowledge of soy utilization at household level, weak industrial base for soy processing, unattractive production package to farmers and lack of market for the crop as major challenges to the production of the crop.

In South Africa, TecnoServe (2010) points out that land is a constraint for soy production. It argued that for South Africa to meet the 2015 demand projections for soybean, land would have to increase by at least 69%, which will require reallocating land from maize to soy. It further argued that land reforms could displace current commercial soy farmers which will decrease soy production.

Also, in Canada, Soy 20/20 (undated) indicates that the major issues facing growers of soybeans has to do with rising costs for inputs (for instance, fertilizer, chemicals, seed, among others); increased pests—soybean aphids, Soybean Cyst Nematode (SCN), soybean rust; export market acceptance of Genetically Modified (GM) soybeans; genetic development of conventional soybean varieties.

Techno Serve (2010) in its analysis of the soybean value chain in Malawi noted that soybean yields are low due to low usage and availability of inputs and poor agronomics, which in turn reduces the profitability of farmers; the processing industry is self-sufficient and expanding, driven by the markets for poultry feed, Corn Soy Blend (CSB), and cooking oil. The paper argued that for Malawi to take advantage of the growing demand, it must address a number of challenges in the value chain, focusing on raising yields and increasing production. It further noted that the lives of smallholders could be improved by improving the value chain.

Kapuya et al., (2010) found that the constraints within the soybean industry occur at both the farm and processing level of the value chain which make the overall productivity in the soybean sector poor and uncompetitive. This has been attributed to several factors which include: the need for increased irrigation capacity and to

refurbish available irrigation facilities; improved farm level financing; reliable supply of low-cost inputs (e.g. seed, fertiliser and electricity); increased investment in processing physical infrastructure; increased foreign direct investment; and removal of stringent importation requirements.

2.5 Empirical Literature on Private and Social Profitability

Arisudi and Gapor (2008) assess the competitiveness of soybean production in Blitar-East Java in Indonesia. Their results indicate that, using technology (applied seed WILIS 2000) provides a higher private and social profit than traditional technology. Also, the more multi cropping and technology implementation, the more efficient the cropping system or higher profit can be achieved easily. All the systems provide a high social profit implying that government subsidy and protection to soybean production is not so important. In other words, the domestic soybean production is still competitive against imported soybean. It was also found that low private revenue is caused by lower price received. A high cost of tradable input was caused by trading system in which farmers take tradable input before harvest time in kiosks and pay higher price after harvest. In general, domestic factor paid by the farmers is lower than social price caused by a cheaper land rent than social price. Based on these results, the paper recommends that government should play an "equity" role in enhancing and distributing welfare among stakeholders. Government policy should target both input and out markets. Government should also, promote the use of improve technology (seed WILLIS 2020). Again, government should develop a financial institution that can fulfil farmer needs for competitive credit since many non formal credit institutions have existed to provide credit with high interest rate.

Moreover, government should provide more opportunities to the farmers accessing credit.

Aji (2003) in his analysis of efficiency and competition of soybeans farming system in Jember shows that, even at the current levels of productivity, soybeans yield a profitable return to land and management at both private and social prices. Farmers who have switched to the new seeds developed by Indonesian researchers have been able to increase productivity (and profits) substantially. This result suggests that government decision to reintroduce import tariffs on soybeans would be undesirable and would lead to inefficiencies in the use of domestic resources. The author recommends that Government investments in soybean production that are likely to have a high benefit-cost ratio are extension activities that educate farmers on the proper seed bed preparation and planting procedures for the new varieties as well as cold storage facilities that hold seeds at the proper temperature before planting. General improvements in credit facilities that make it easier for farmers to innovate would also be desirable.

Dipokusumo et al. (2003) examine the impact of agricultural policy on soybean production in West Nusa Tenggara Province. Their analyses pointed out that both soybean production systems (wet and dry lands) were profitable (socially and privately). This means that farmers have an incentive to grow soybeans under the current (no tariff) policy regime. Positive social profits indicate that soybeans also have a comparative advantage in West Nusa farming systems. Under these circumstances there is no justification to distort prices in an effort to increase land devoted to soybeans. The study recommends that Government intervention should

focus on improved extension services and better research programs that would lead to more productive soybean varieties.

Filho et al. (2009) in their study of the competitiveness of soybean agri-systems in Brazil, Argentina and Paraguay, state that the Competitiveness of an agri-system takes into account the verticality of the economic system and the combined impact of several factors. These factors are taken as drivers of competitiveness, from which critical points can be object of public and private efforts. In this sense, seven critical points can be pointed out in this agri-system: Technology, Logistics, and Food Safety, Market structure, Special programs, Firm management and Taxation.

Jierwriyapant and Hadi (1991) analyse the comparative advantage of Soybean and Competing Crops in Chiang Mai Province, in Thailand. The result of this study indicates that soybean production in Chiang Mai province is efficient but not competitive. The negative private profit indicates that the return for labour for soybean farmers is less than market wage rates. Onion and garlic production are both socially and privately profitable. The domestic resource cost ratio (DRC) coefficients indicate that the production systems of garlic and onion in Chiang Mai province are socially profitable. However, the production of soybean seed is efficient only under an export regime which presupposes high quality seed. The result also shows that onion production has comparative advantage over the other two crops.

Hermanto et al. (1991) compare local comparative advantage of soybean production: cases from East Java, Indonesia. The results show that maize production yields more cash income than soybean production in Blitar. However, if profitability is viewed in

relative terms, as expressed in PCR, then we can see that the PCR of maize is similar to that of soybean. This implies that if a farmer is concerned about cost efficiency, according to this data, maize and soybean are equally attractive choices in Blitar. From the efficiency point of view, the benefit of planting maize is higher than the benefits from planting soybean. The economic efficiency as measured by DRC ratio is consistent with the analysis of social profit. In Jember rice is financially more profitable than soybean. However, the PCR value of rice is only slightly lower than that of soybean. This indicates that crops as rice or soybean are equally attractive to farmers who are concerned about cost efficiency. The social profit figures of soybean and rice indicate that the rice farmers receive more benefit from the government's present price policy than the soybean farmers. The DRC ratio figures of rice and maize show that planting rice was more economically efficient than planting soybean. From this discussion, the authors infer that soybean is a commodity which has good prospects for development especially in the areas where the agro-ecological conditions are favourable for soybean production, such as in Jember. In this region, soybean can be regarded as both privately and socially profitable, and an alternative commodity to rice. The development of soybean in marginal land, under the present technology, crop management and infrastructure, will be socially non-profitable.

Empirical Literature on Other Commodity Systems

Arsanti et al., (2007) analyse resource use efficiency and competitiveness of vegetable farming systems in Upland Areas of Indonesia. The results show that most of the VFS activities use resources efficiently, competitive and have comparative advantages, even though they are connected with poor distribution system. The farming system of potatoes and tomatoes has the highest competitiveness in Pangalengan and Berastagi-

Simpang Empat. However, the category with no competitiveness is VFS of headed cabbages in Berastagi-Simpang Empat considered as less advantageous products. This is attributed to: (1) low market values of land for the cultivation, resulting from price and policy distortion, depressing further the rental rate, (2) misapplication of chemical input, (3) high cost per unit; (4) low productivity level and (5) low market prices. Moreover, most of the social prices for vegetables are higher than private prices with an exception for potatoes and carrots in Berastagi-Simpang Empat. This is mainly due to higher growth of demand in addition to the protective policy. As far as output prices are concerned, Indonesia has a comparative advantage in the production of vegetables. Some programs are necessary to be created by the government in order to support the development of VFS in upland areas, especially for potato and cabbage based on the agro- ecosystem or infrastructural in each region.

Food and Agriculture Organization (FAO) (2004) measures the comparative advantage of crop production systems in Syria. The results conclude that all the systems achieved a positive profit at private prices, the highest profit per hectare being achieved by tomatoes, followed by orange and olive production. Field crops such as cotton and wheat achieved a much lower return per hectare compared to the tomato and perennial production systems. However, cotton still generates a profit that is around four times the profit per hectare obtained by wheat-based systems, while flour production yields the lowest profit per hectare. The groups that achieved the highest profit at private prices were tomatoes, fresh oranges, and olive oil, while the field crops (hard wheat flour and soft wheat) maintained their profitability. In the livestock group, only the production of packed milk was socially profitable while

meat production became unprofitable in live or fresh meat form. Cotton production was also not profitable at its social price.

Ahmad and Martin (2000) investigate the efficiency of Pakistani agriculture and the effect of policy interventions in six primary agricultural systems: wheat, rice, cotton, maize, sugarcane, and potatoes. Of these six systems, only wheat was found to be socially inefficient. Cotton and rice, in contrast, were found to be highly profitable both privately and socially. Pakistan appears to enjoy a considerable comparative advantage in the production of both crops.

Ogbe *et al*. (2011) assess the competitiveness of Nigerian rice and maize production ecologies. Their PAM results revealed that outputs from the Production ecologies are taxed. This was further confirmed by the Effective Protection Coefficient (EPC) and Subsidy Ratio to producers (SRP) values, however, the production ecologies are subsidized on the use of tradable inputs. The production ecologies demonstrate a strong competitiveness at the farm level (under irrigated rice, upland rice and upland maize) and a strong comparative advantage. Sensitivity analysis indicated that a 50 percent increase in output and a 13.3 percent depreciation of the domestic currency will increase competitiveness and comparative advantage of rice and maize production in all ecologies. The study recommends that government should ensure a level of policy stability in the rice and maize sectors assist farmers with irrigated water scheme to ensure constant water supply, and increase the level of output through provision of improved seed varieties.

Seini (2004) assesses the efficiency of agricultural commodity systems under policy reforms in Ghana; the results indicate that the net effect of policy reforms is the reduction of the domestic market price and revenue below the world price by 16%, 14%, 18%, 10%, and 33% for maize, rainfed rice, irrigated rice, cassava and cotton respectively. However, the policy reforms raised the domestic price of oil palm above the world price by 75%. With respect to resource use, the study shows that labour claims the largest cost share in the production of most crops at the farm level with the exception of irrigated rice and oil palm. At the post farm level, cost share tend to be a little bit different. Imported capital equipment and intermediate inputs become more important than labour. The study concludes that with the exception of pineapple, all the other commodities studied are socially profitable. Despite the recent increases in the export of pineapples, the commodity has no comparative advantage and is also privately unprofitable and therefore uncompetitive and inefficient, given the current state of the arts being employed in its production.

Keyser (2007) studied the Commercial Competitiveness of African Agriculture (CCAA) in Mozambique, Nigeria, and Zambia. His results indicates that in these countries, as elsewhere, the restoration of agricultural competitiveness depends on a number of factors, including the technical performance of agricultural commodity chains (comprising production, assembly, processing, and exchange activities); supply and demand conditions in domestic, regional, and global markets; and the appropriateness of the institutional and policy environment.

2.6 Soybean Production Systems

According to Pearson et al., (2003) PAM researchers' should select representative systems and stratify the population of farmers according to two or more of a number of different stratification variables: commodity for instance which crop(s) and cropping rotation(s); agro-climatic zone – differing by rainfall, soils, elevation, and slope; season of production – one wet season and one or two dry seasons; agricultural technologies – identified by water control, inter-cropping; improved seeds, modern inputs, and mechanization; and areas cropped (for example owned, rented-in, and rented-out).

Keyser (2007) in his study of the competitive of commercial agriculture in Africa classified farmers in to four groups/sectors-smallholder farmers, emergent farmers, commercial farmers and corporate farmers. He described smallholder farmers as Small-scale farming households who together cultivate about 80% of the total land with farm sizes from 1 to 5 hectares, with an average area of 2 hectares. They practice low-input, low-output production and depend on family labour and hand tools with limited use of oxen. Medium-scale or emergent farmers have farm sizes of between 5 and 20 hectares. These farmers produce largely for the market and employ both hired and family labour. The majority of emergent farmers use animal traction although some may also have a second-hand tractor. Large-scale farmers are large-scale commercial farmers with agricultural holdings that sometimes go up to several thousand hectares. Large-scale commercial farming is mechanized and often employs high-level production and management technology. Corporate farms are very large scale operations covering 1,000ha or more and often include vertically integrated processing units.

In Thailand, Japan, and Australia, a common soybean production practice by farmers is intercropping soybean with cassava (Benjamin & Lampong, 1985; Tsay et al., 1987). In Ghana, (Ennin et al., 2005) argued that soybean needs to be adapted in to existing cropping systems in order to facilitate adoption by farmers. Their paper found that planting soybeans 2 weeks before cassava was the most productive, with 52 per cent yield advantage compared to sole cropping. However, biological efficiency did not imply economic efficiency and planting soybeans 4 weeks after cassava was the most profitable, with net benefits 500 per cent higher than sole cropped soybean. The paper concluded that intercropping of soybean has been found to be a productive, profitable and an attractive production system for soybeans in Ghana.

2.7 Conclusion

This review of the concept of competitiveness in soybean production, which does not claim to be exhaustive, has highlighted several points that have informed this present study. The term competitiveness is a broad concept which means different things to different people depending on the context and level of measurement. Among the three levels of competitiveness, firm level competitiveness is the one that has gained the attention of researchers and this is because it is firms and not nations that compete in the international arena. Therefore, nations are able to compete provided their firms are competitive. The literature also, made a distinction between comparative advantage and competitiveness. The former concerns itself with efficiency in the use of a nation's resources and the latter deals with the profitability of individual firms. Basically, the literature review has informed the choice of the methods of analysis used in this study as well as the conceptualization and measurement of

competitiveness. Also, the theoretical and empirical literature made the interpretation of results of this present study possible

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter covers an overview of the study area, methods of analysis, empirical model and estimation procedures, statement of hypothesis, validation of hypothesis, data collection (types and sources of data, sample size and sample techniques, survey instruments, and data analysis- computer packages used), classification of farmers by size of production, and an overview of the study area.

3.2 Theoretical Foundation

Most goals of government policy fall under one of three fundamental objectives (efficiency, equity, or security) (Pearson et al., 2003). Efficiency is achieved when the allocation of scarce resources in an economy produces the maximum amount of income and the allocation of goods and services brings highest consumer satisfaction. Equity refers to the distribution of income among groups or regions that are targeted by policy makers. In a democratic society the citizens usually determine what constitutes equity. Security is furthered when political and economic stability allows producers and consumers to minimize adjustment costs. Food security refers to the availability of food supplies at affordable and stable prices. In this framework, any goal that a policymaker is hoping achieve through government intervention will be incorporated within one of the three fundamental objectives.

Researchers (Pearson et al., 2003; Monk and Pearson, 1989; Seini, 2002), among others, have classified policies influencing the agricultural sector into one of three categories (agricultural price policies, macro-economic policies, or public investment

policies). Macro-economic policies consist of mainly fiscal, monetary and exchange rate policies. These are normally set for the entire economy and planners rarely decide macro policies to benefit agriculture sector alone. Despite this, the effects of macro policies on agriculture need to be well understood.

Public investments provide one important means of intervening directly to change agricultural costs or returns. This policy instrument allows expenditure from the public purse on "public goods" items on which private investors have difficulty appropriating their benefits (primarily because of the inherit characteristics of non-rivalry and non-excludability that are associated with such goods) and hence under invest in them. These include research and extension work, transport, infrastructure, irrigation facilities, and health institutions (Seini, 2002).

The third category of these policy instruments is agricultural price policies. These policies are usually specific to individual commodities and create transfers either to or from the producers or consumers of the affected commodity and the government budget. Some price policies affect only two of these three groups, whereas other instruments affect all three groups (Pearson et al., 2003). The first of them is made up of specific policies that raise or lower the domestic price of tradable commodity relative to the comparable world price. Such instruments that affect price level include domestic taxes, subsidies and international trade policies which may include taxes, subsidies and quantitative restrictions on imports or exports. Taxes and subsidies on agricultural commodities result in transfers between the public budget and producers and consumers. Taxes transfer resources to the government, whereas subsidies

transfer resources away from the government. For example, a direct production subsidy transfers resources from the government budget to agricultural producers.

Price stabilisation policies, the second of this group, on the other hand reflect government's desire to stabilise domestic prices (usually on primary food staples). The third of this group consists of direct controls which are government regulations of prices, marketing margins, or cropping choices. Typically, direct controls must be accompanied by trade restrictions or taxes/subsidies to be effective (Pearson et al., 2003).

Governments intervene in agriculture for several reasons. One of such reasons is to correct market failures. In the presence of market imperfections, prices of goods and services do not reflect their true opportunity costs because the private sector is not able to develop the institutions necessary for efficient market outcomes (Monk and Pearson, 1989). Market failures arise as a result of market power, externalities and poor development of institutions and imperfect information to provide competitive services.

Even though policies to improve the efficiency of markets are important, the commonest rationale for government intervention in developing country agriculture is the furthering of non-efficiency objectives. The creation of an efficient economy and the maximization of national income are often not the only goals of economic policy. When policy makers are dissatisfied with the implications of income maximization, policies are formulated to alter the economy. Such policies usually border on income distribution concerns, price stabilization and national concern over the appropriate role for agriculture in the economy (Monke and Pearson, 1989).

In the absence of interventionist policies in the market, the domestic prices of tradable inputs and output will converge at the world (parity) prices. However, government interventions to further non-efficiency objectives especially, causes observed prices of inputs and output to diverge from their counterpart efficiency prices.

The policy analysis matrix which is basically an application of social cost-benefit analysis and the concepts of trade theory to policy analysis is suited to this study since the study aims at measuring the transfer effects of policy on a commodity system which has much to do with production costs, benefits and trade. PAM also, enables us to analyse private and social profitability of a commodity system in order to establish its competitiveness (Seini, 2002).

3.3 Methods of Analysis

3.3.1 Empirical Framework of the Policy Analysis Matrix

The Policy Analysis Matrix (PAM) is used to analyze the private and social profitability of soybean production in the Upper West Region. The method is also employed to measure the divergence caused by distorting policy and/or market failures. This framework was developed by Monke and Pearson (1989), and augmented by recent developments in price distortion analysis by Masters and Winter-Nelson (1995).

PAM is a tool that allows us to examine the impact of policy by constructing two enterprise budgets, one valued at market prices and the other valued at social prices. The PAM, once assembled, provides a convenient method of calculating the measure of policy effects and measures of competitiveness and economic efficiency or

comparative advantage. A wide range of government policies have influences on protection or disprotection of agricultural production, which can be measured by using nominal and effective protection rates as indicators. This framework is particularly useful in identifying the appropriate direction of change in policy (Gonzale *et al*., 1993).

Table 3.1 presents the empirical framework of the policy analysis matrix following what was estimated in Pakistan by (Akhtar et al., 2007). As indicated earlier, PAM is a product of two accounting identities; one defining profitability as the difference between revenues and costs; and the other measuring the effect of divergences. The indicator in the first row of Table 3.1 provides a measure of private profitability (D), or competitiveness, and is defined as the difference between observed revenue (A) and costs (*B*+*C*). Private profitability demonstrates the competitiveness of the agricultural system, given current technologies, prices for inputs and outputs, and policy interventions and market failures (Monke and Pearson, 1989). The second row of the matrix calculates the measure of social profitability (H) defined as the difference between social revenue (E) and costs (F+G). Social profitability measures economic efficiency or comparative advantage of the agricultural system. While the effects of divergences concerns the difference between private and social valuations of revenues (I=A-E), costs (J=B-F, K=C-G) and profits (L=D-H).

Table 3.1: Empirical Framework of Policy Analysis Matrix (PAM)

	Revenues	Cost		Profit
		Tradable Input	Domestic Resources	
Private Prices	A	B	C	D
Social Prices	E	F	G	H
Divergence	I	J	K	L

Source: Monk and Pearson (1989)

$Output\ Transfer: I = A - E$

$Tradable\ Input\ Transfer: J = B - F$

$Factor\ Transfer: K = C - G$

$Net\ Policy\ Transfer: L = D - H = I - J - K$

Private Profitability

The term private refers to observed revenues and costs reflecting actual market prices received or paid by farmers, merchants, or processors in the agricultural system (Monk and Pearson, 1989). The private or actual market prices thus incorporate the underlying economic costs and valuations plus the effects of all policies and market failures (Pearson et al., 2003; Monke and Pearson, 1989). The calculation begins with the construction of separate budgets for farming, marketing, and processing. The components of these budgets are usually entered in PAM as local currency per physical unit, although the analysis can also be carried out using a foreign currency per unit. In all these computations, it is usually average data for all respondents that are used but not individual respondents.

The private profitability demonstrates the competitiveness of the agricultural system, given current technologies, prices of output and input and policy (Mohanty et al., 2002, Ogbe et al., 2011; Monke and Pearson, 1989; Esmaeili, 2008). Also, Seini (2004) indicates that profits in private prices provide a measure of the short to

medium-term financial viability of the commodity system from the operator's perspective, and suggest to what degree the system may attract further investment. The cost of capital, defined as the pre-tax return that owners of capital require to maintain their investment in the system, is included in domestic costs (C); hence profits (D) are excess profits-above-normal returns to operators of the activity. If private profits are negative, operators are earning a subnormal rate of return and thus can be expected to exit from this activity unless something changes to increase profits to at least a normal level (D = 0). Alternatively, positive private profits (D > 0) are an indication of supernormal returns and should lead to future expansion of the system, unless the farming area cannot be expanded or substitute crops are more privately profitable.

Social Profitability

Social profits measure comparative advantage or efficiency. Efficient outcomes are achieved when an economy's resources are used in activities that create the highest levels of output and income (Pearson et al., 2003). Social profits, H, are an efficiency measure because outputs, E, and inputs, F + G, are valued in prices that reflect social opportunity costs. Social profits, like the private counterparts, are the difference between revenues and costs, all measured in social prices-H = (E - F - G).

For outputs (E) and inputs (F) that are traded internationally, the appropriate social valuations are given by world prices-cif import prices for goods or services that are imported or fob export prices for exportables. World prices represent the government's choice to permit consumers and producers to import, export, or produce

goods or services domestically; the social value of additional domestic output is thus the foreign exchange saved by reducing imports or earned by expanding exports (for each unit of production, the cif import or fob export price). Because of global output fluctuations or distorting policies abroad, the appropriate world prices might not be those that prevail during the base year chosen for the study. Instead, expected long-run values serve as social valuations for tradable outputs and inputs (Monke and Pearson, 1989).

The services provided by domestic factors of production (labour, capital, and land) do not have world prices because the markets for these services are considered to be domestic. The social valuation of each factor service is found by estimation of the net income forgone because the factor is not employed in its best alternative use. This approach requires the commodity systems under analysis to be excluded from social factor price determination. For example, if land is planted to maize, it cannot grow millet during the same crop season; the social opportunity cost of the land for the maize system is thus the net income lost because the land cannot produce millet. Similarly, the labour and capital used to produce maize cannot simultaneously provide services elsewhere in agriculture or in other sectors of the economy. Their scarcity values are measured by the net income given up because alternative activities are deprived of the labour and capital services applied to maize production (Monke and Pearson, 1989 and Pearson et al,. 2003).

The practice of social valuation of domestic factors begins with a distinction between mobile and fixed factors of production (Monke and Pearson, 1989). Mobile factors, usually capital and labour, are factors that can move from agriculture to other sectors

of the economy, such as industry, services, and energy. For mobile factors, prices are determined by aggregate supply and demand forces. Because alternative uses for these factors are available throughout the economy, the social values of capital and labour are determined at a national level, not solely within the agricultural sector. Actual wage rates for labour and rates of return to capital investment are therefore affected by a host of policies, some of which may distort factor prices directly. An enforced and binding minimum wage law, for example, raises the market wage above what it would have been in the absence of policy and causes observed wages to be higher than the social opportunity cost of labour. But indirect effects can also be important. Distortions of output prices cause different activities to expand or contract, altering in turn the demand and prices of mobile domestic factors.

Fixed (or immobile) factors of production are the factors whose private or social opportunity costs are determined within a particular sector of the economy (Pearson et al., 2003). The value of agricultural land, for example, is usually determined only by the land's worth in growing alternative crops. Because land is immobile, its value is not directly affected by events in the industrial and service sectors of the economy. But the social opportunity cost of farmland is sometimes difficult to estimate. Within any agro-climatic zone, complete specialization in the most profitable crop is rarely observed (Pearson et al., 2003). Instead, farmers prefer rotations or intercropping systems that reduce risks of income losses from price variability, yield losses, and pest and disease infestation. Therefore, the social opportunity cost of the land is not accurately approximated by the net profitability of a single best alternative crop; instead, it is measured by some weighted average of the social profits accruing from the set of crops planted. Because the correct weights and social profits associated with

each crop in the set are generally not known, it is convenient in assessing farming activities to reinterpret crop profits as rents to land and other fixed factors (for example, management and the ability to bear risk) per hectare of land used. This reinterpretation includes private (and social) returns to land as parts of D (and H). Profitability per hectare is then interpreted as the ability of a farming activity to cover its long-run variable costs, in either private or social prices or as a return to fixed factors such as land, management skill, and water resources.

Social profit for any agricultural system under analysis can either be positive or negative. On one hand, (Salam and Rahmadani, 2003) indicate that when commodities have positive social profits, the country has a comparative advantage in producing that commodity. So that additional incentives in the form of tariffs or other types of protection are unnecessary. Alternatively, Nelson and Panggabean (1991) and Keyser (2007) are of the view that a positive social profit indicates that the system uses scarce resources efficiently and contributes to national income. While Mohanty et al., (2002) is of the view that a positive social profit indicates that the country uses scarce resources efficiently and has a static comparative advantage in the production of that commodity at the margin. On the other hand, a negative social profit indicates social inefficiencies and suggests that production at social costs exceed the costs of import, thus indicating that the sector cannot survive without government intervention (Nelson and Panggabean, 1991; Keyser, 2007). Similarly, Mohanty et al., (2002) indicate that negative social profits suggest that the sector is wasting resources, which could have been utilized more efficiently in some other sector. In other words, the cost of domestic production exceeds the cost of imports suggesting that the sector cannot survive without government support.

Effects of Divergences

The second identity of the accounting matrix concerns the differences between private and social valuations of revenues, costs and profits. For each entry in the matrix measured vertically any difference between the observed actual market price and the estimated efficiency price is explained by the effects of policy or by the existence of market failures (Monke and Pearson, 1989; Mohanty, *et al.*, 2003; Wiendiyati, *et al.*, 2002; Esmaeili, 2008,). Market failures occur whenever monopolies or monopsonies, externalities and factor market imperfections prevent a market from creating an efficient allocation of products or factors.

Social prices correct for the effects of distorting policies. These are policies that lead to an inefficient use of resources. These policies are often introduced because decision-makers are willing to accept some inefficiency in order to further non efficiency objectives, such as the redistribution of income or the improvement of domestic food security. It must be noted that not all policies distort the allocation of resources. Efficient policies are enacted to improve efficiency (Pearson et al., 2003). Hence, one needs to distinguish distorting policies, which cause losses of potential income, from efficient policies, which offset the effects of market failures and thus create greater income. Because efficient policies correct divergences, they reduce the differences between private and social valuations (Monke and Pearson., 1989; Pearson et al., 2003).

In the PAM framework, any wedge between private and social valuations of revenue and costs create transfers. From Table 3.1, four types of such transfers are observed output transfers (i.e. I=A-E), tradable inputs transfer (J=E-F), factor transfers (K=C-

G) and net policy transfer (L=D-H or L=I-J-K). According to Tarumun (2004) output transfers occur because domestic prices are higher than comparable international prices. On one hand, when output transfers are positive it usually suggests that domestic production is protected by policy. On the other hand, when output transfers are negative, it implies that domestic production is disprotected by policy. In this sense, farmers under the concerned agricultural system receive lower prices for their output than they would have received if their outputs were valued at the prevailing world price (Ahktar et al., 2007).

Similarly, when tradable input transfers are positive, i.e. when the private costs of the tradable inputs are higher than their corresponding social costs, it indicates that the system is taxed by policy. On the contrary, if tradable input transfer is negative, it implies that the system's cost are subsidized by policy (Tarumun, 2004). Net transfers provide a summary of the effect of government policies or market failures on commodity systems (Msi, 2003). A positive net transfer indicates that incentive policies are being implemented. Conversely, a negative net transfer indicates that farmers have a disincentive to produce the commodity.

3.3.2 Competitiveness and Economic Efficiency Indicators

The PAM framework can also be used to calculate important indicators for policy analysis. The following measures were computed for Ghana's Upper West Region based on what was established for Pakistan by Appleyard (1987), Salman and Martini (2000), Chaudhry and Kayani (1999)

Nominal Protection Coefficient on Output (NPCO)

The nominal protection coefficient on output is a ratio of private revenue to social revenue expressed as:

$$NPCO = \frac{A}{E} \qquad (1)$$

This ratio shows the extent to which domestic prices for output differ from international reference prices. If NPCO is greater than 1, the domestic farm gate price is greater than the international price of output and thus the system receives protection. On the contrary, if NPCO is less than 1, the system is disprotected by policy.

Nominal Protection Coefficient on Input (NPCI)

NPCI is the ratio of tradable input cost in private prices to tradable input cost in social prices. It is expressed as:

$$NPCI = \frac{B}{F} \qquad (2)$$

This ratio shows how much domestic prices for tradable inputs differ from their social prices. If NPCI exceeds 1, the domestic input cost is greater than the comparable world prices and thus the system is taxed by policy. If NPCI is less than 1, the system is subsidized by policy.

Effective Protection Coefficient (EPC)

EPC is the ratio of the difference between revenues and tradable input costs (value added) in private prices to value added in social prices (world prices) expressed as:

$$EPC = \frac{A - B}{E - F} \qquad (3)$$

This ratio shows by how much policies in the product markets cause observed value added to differ from what it would be in the absence of commodity price policies. An EPC value of greater than 1 suggests that government policies provide positive incentives to producers, while values less than 1 indicate that producers are disprotected through policy interventions on value added.

Domestic Resource Cost (DRC) Ratio

The DRC is the ratio of social factor cost (G) to value added in social prices (E-F) expressed as:

$$DRC = \frac{G}{(E - F)} \qquad (4)$$

The DRC was brought into common use by Bruno (1972) specifically for the purpose of measuring comparative advantage. According to Bruno (1972) and Krueger (1966 and 1972), the economic efficiency in domestic resource use of a commodity system can be assessed by using this ratio. Since minimizing the DRC is equivalent to maximizing social profits, if the DRC ratio is less than 1, the system uses domestic resources efficiently. If the DRC ratio is greater than 1, then the system shows inefficiency in domestic resource use and possesses a comparative disadvantage.

Private Cost Ratio (PCR)

PCR is the ratio of domestic factor costs (C) to value added in private prices (A-B). It is expressed as:

$$PCR = \frac{C}{(A - B)} \qquad (5)$$

This ratio measures the competitiveness of a commodity system at the farm level. The system is competitive if the PCR is less than 1.

3.4 Estimation Procedures

3.4.1 Estimation of Private prices

Private prices are the actual observed prices of all inputs and output at the farm-gate (Monke and Pearson, 1989). This data was derived from in-depth interviews and questionnaires.

Labour

To compile detailed farm budgets, this study classified labour into categories according to gender (female or male) and age (child or adult). The observed data on private wage rates (multiplied by the labour input coefficients) were averaged and then entered into box C in the PAM. The market wage rate for children in the study area was not different from the adult wage rate. However, in terms of sex there were slight differences in the wage rates for male and female labour but in different activities. This was because division of labour was along gender lines. Female labour featured predominantly in activities such as planting and harvesting. While their males counter parts were more into land preparation, weeding, pest control and thrashing.

Land

The observed market price of farm land in the UWR was estimated based on what farmers pay per acre of farm land. In most cases respondents could not give an amount at which their lands were acquired. However, the few responses were averaged to arrive at the land rent. The survey shows that land market is not properly developed in UWR.

Capital

The cost of capital was estimated based on what farmers pay per hour of tractor service plus working capital (see Appendix VII).

3.4.2 Private Budgets

Private profitability is defined as the difference between the soybean produced and the costs of all inputs used in production, all valued in actual market prices. Private profits thus combine the underlying economic costs and valuations plus the effects of all policies and market failures (Monke and Pearson, 1989). The private budgets were constructed by multiplying the quantities in the input-output table by their related prices in the private prices table.

3.4.2 Estimation of Social Prices

Social prices are referred to as shadow prices, economic prices, or accounting prices. Social prices of commodities and domestic factors are all related to world market commodity prices (Jierwriyapant and Hadi, 1991). These social prices represent efficiency prices and do not incorporate non-efficiency objectives (Monke and Pearson, 1989).

According to (Yao, 1997 and Pearson et al., 2003) the most difficult tasks for constructing a PAM are estimating social prices for outputs and inputs and decomposing inputs into their tradable and non-tradable components. Monke and Pearson (1989) indicate that world prices are used as reference prices for the computation of social prices for tradable inputs and outputs of various commodities.

Outputs

The social price of soybean output was estimated based on comparable import prices for Ghana soybean. Cif prices were used as the social price. However, the cif price of soybean was adjusted by transportation and handling costs from the port of Tema to Wa to arrived at the social cost at the farm gate (see Appendix IX). The social price of non-tradable outputs was estimated by correcting their private prices for divergences (distorting policies and market failures). In situation(s) where the effects of divergences cannot be estimated, Monke and Pearson (1989) suggested that the price of a close substitute commodity should be used as a proxy for the social price of the non-tradable commodity. If that search fails, the last step is to seek the price of the same commodity (or a close substitute) in a neighbouring country.

Tradable Inputs

The tradable inputs captured in this study include fertilizer, soy seed and chemicals (pesticides and weedicides). Import parity prices (specifically c.i.f prices) were used to calculate the social prices of these importable tradable inputs.

3.4.4 Estimation of Domestic Factors

The domestic factors considered in this study comprise labour, capital and land.

Labour

The social value of farm labour was set equal to its private wage rate. Careful observation shows that no distorting policies or market failures significantly influenced the market for unskilled labour especially in the farm sector. Monk and Pearson (1989) state that minimum wage law and pension and health insurance taxes are two types of distorting policies that might affect rural labour sub-markets in developing countries. These kinds of policies are widespread in developing and developed countries, but they often are not well enforced in agriculture (except in plantations and processing plants). The only distorting policy that could affect wage rate is the minimum wage rate law which is not enforced in the farm sector in Ghana.

Several studies (e.g. Aji, 2003; Budastra and Dipokusumo, 2004; Tarumun, 2004; Salam and Rahmadani, 2003; and Perdana, 2003) in their PAMs have assumed that in the absence of distorting policies and market failures in the labour market, the private wage rate is usually a good approximation of social wage rate. Also, Seini and Asante (1998) in their PAM assumed that rural Wage rates in Ghana were competitive. Mane-Kapaj et al., (2010) state that in areas where labour markets are competitive, and there is surplus of labour relative to available opportunities, the opportunity cost of labour is assumed to be reflected in the private wage rate.

Land

The social valuation of land follows the social opportunity cost principle (Pearson et al., 2003). From the point of view of the national economy, the social land rental rate was found by estimating the social profit (H) of the land in its best alternative use when all costs of land are excluded. The social opportunity cost of land planted to soybean was estimated by calculating the net returns from the next best alternative crop (maize) for each soybean farmer after which the returns were averaged on a per acre basis to arrive at the social opportunity cost of land (see Appendix VII).

Capital

The social price of capital was estimated by adjusting the private cost of capital with the prevailing Bank of Ghana's lending rate of 30% in the year 2011(see Appendix VI).

3.4.5 Social Budgets

Social profitability is defined as the difference between the value of soybean produced and the costs of all inputs used in production, all valued in social (efficiency) prices. Social profits thus reflect only the underlying economic costs and valuations and are free of the effects of all policies and market failures (Monke and Pearson, 1989). The social budgets were constructed by multiplying the quantities in the input-output table by their related prices in the social prices table.

3.5 Ranking of Constraints

The third objective of this study which is to identify and rank the constraints to soybean production in the Upper West Region is achieved using Kendall's coefficient of concordance statistics. The Kendall's coefficient of concordance analysis is used to

test for the agreement of the rankings by the respondents. To this end, literature has been reviewed and the constraints to soybean production have been identified. Respondent were asked to rank these constraints identified from the literature.

The Kendall *W* statistic is an estimate of the variance of the row sums of ranks (R_i) divided by the maximum possible value the variance can take; this occurs when all variables are in total agreement. Hence, $0 \leq W \leq 1$, where 1 represents perfect concordance. There are two ways of computing Kendall's *W* statistic (i.e. either form of equations 1 and 2, below); they lead to the same result. The computation proceeds in two steps. Firstly, S is computed from the row-marginal sums of ranks (R_i) received by the objects:

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

Where S is a sum-of-squares statistic over the row sums ranks (R_i). $\bar{R}$ is the mean of the R_i values. Secondly, Kendall's W statistic is obtained using either of the following equations:

$$W = \frac{12S}{p^2(n^3 - n) - pT} \qquad or \qquad W = \frac{12S - 3p^2n(n+1)}{p^2(n^2 - n) - pT}$$

Where n is the number of objects and p the number of variables. To derive these formulas, one has to know that the sum of all ranks in the data table is $pn(n+1)/2$ and that the sum of squares of all ranks is $p^2n(n+1)(2n+1)/6$. T is a correction factor for tied ranks (Siegel, 1956; Siegel & Castellan, 1988; Zar, 1999):

$$T = \sum_{k=1}^{n} ({t_k}^3 - t_k)$$

In which T_k is the number of tied ranks in each (k) of g groups of ties. The sum is computed over all groups of ties found in all p variables of the data table. T = 0 when there are no values.

Testing the Significance of W

The recommended method to test the significance of *W* is to compute the following F statistic:

$$F = \frac{(p-1)W}{(1-W)}$$

This is asymptotically distributed like F with $v_1 = n - 1 - \left(\frac{2}{p}\right) and\ v_2 = v_1(p-1)$ degrees of freedom (Kendall & Babington Smith, 1939). Numerical simulations showed that this *F* statistic had correct levels of type I error for any value of *n* and *p* (Legendre, 2010).

Statement of Hypothesis

H_0: there is no agreement among soybean farmers regarding the rankings of constraints to soybean production in the Upper West Region.

H_1: there is agreement among soybean farmers regarding the rankings of constraints to soybean production in the Upper West Region.

Validation of Hypothesis

Data is validated by comparing the calculated F to the critical F. If the calculated F is greater than the critical F we reject the null hypothesis otherwise; we do not reject the null hypothesis.

3.6 Data Collection

3.6.1Types and Sources of Data

The study made use of data from both primary and secondary sources. Farm level data was collected from 200 soybean farmers in five of the eight districts in the Upper West Region. The selection of these districts was informed by their dominance in the production of soybeans in the Upper West Region. These are also the district where the SRID unit of MoFA has consistent data on. Secondary data was obtained from several related institutions. For instance, farmer groups, agro-industry associations, marketers associations, SARI, ADRA, Ministry of Food and Agriculture, Ministry of Trade and Industry, local experts, FAOSTATS, CSIR, GSS, annual reports from the State of the Ghanaian Economy, annual reports of Upper West Agro- industry, peer reviewed journals and other relevant materials to support the primary data.

The data covers the social, economic and demographic characteristics of the survey sample. These include gender, age of the farmer, household size, level of education, access to credit, years of experience with soybean, expenditure in hiring labour, contact with extension service, and access to government subsidy. Other data collected include: specific government policies on soybean production, production cost, private prices for all inputs and outputs, social prices for tradable inputs and outputs, export and import prices of soybean (fob, c. i. f), historical data on planting and harvesting, prices at the farm-gate and wholesale prices, official exchange rate, social prices for domestic resources (wages, interest rates and rent).

3.6.2 Sampling Technique and Sample Size

Farm level data was collected through a survey of 200 soybean farmers in five districts in the region. Therefore, questionnaires were administered to 200 soybean

farmers across the region. The dispersed nature of soybean farmers in the Upper West Region and the lack of comprehensive sampling frame or systematic numbering of soybean farmers precludes the use of stratified and cluster sampling procedures. A multi-stage sampling technique was employed to draw the sample.

All the districts in the Upper West Region were arranged according to their levels of soybean production and the best five were drawn for the study (Table 3.2).

Table3.2: Distribution of Sample Units According to Districts and Communities

District	Community	Sample Size	Percentage	Total
Sissala West	Jebia	10	5.0	
	Wasei	7	3.5	
	Jeffessi	12	5.9	
	Bulu	11	5.4	40
Nadowli	Dakyee	6	3.0	
	Moyiri	2	1.0	
	Bussie	10	5.0	
	Goli	5	2.5	
	Fian	2	1.0	
	Tuori	4	2.0	
	Sombo	5	2.5	
	Serekpere	4	2.0	
	Goriyiri	2	1.0	40
Wa Municipal	Jonga	4	2.0	
	Busah	16	7.9	
	Busah Tangzu	9	4.5	
	Kanpaha	2	1.0	
	Dianaso	3	1.5	
	Doodiyiri	6	3.5	40
Wa West	Goripie	23	11.4	
	Bulenga	17	8.4	40
Wa East	Taniena	10	5.0	
	Boro	4	2.0	
	Gbache	1	0.5	
	Tamaari	15	4.5	
	Doritanga	2	1.0	
	Piisie	5	2.5	
	Lusi	3	1.5	40
Grand Total		**200**	**100**	**200**

Source: Field Survey, 2012

However, sampling at the community level was purposive based on soybean producing communities. At the community level, snowball sampling technique was employed to draw the sample units. A total of 40 soybean farmers were interviewed in each of the five districts (Sissala West, Nadowli, Wa Municipal, Wa West and Wa East) that have been selected for the survey.

As indicated in Table 3.2, a sample size of 200 soybean farmers was distributed among 28 communities across the Upper West Region. The production of soybean is concentrated geographically in some communities as evidenced by Wa West and Sissala West districts in Table 3.2, but sparsely distributed in the rest of the districts except a few communities within those districts.

3.6.3 Survey Instruments

Survey data was gathered through the application of structured questionnaires. Complementary information was obtained through a qualitative approach that used in-depth interviews for gathering information not covered in the farm household surveys. Face-to-face interviews were conducted, as e-mailing the questionnaires for responses will be difficult due to the lack of adequate electronic networks and computer-based communication skills in the Upper West Region. The survey was carried out from December, 2011 to January, 2012 and data was collected for the 2011 crop production year. The questionnaires were developed based on literature review and discussions with soybean industry experts. Prior to the field survey, a preliminary survey was conducted in December to collect information required to test the questionnaire. Also, check list and interview guides were employed to be used when appropriate.

3.6.4 Computer Packages Used

Microsoft-excel and PASW Statistics 18 were used to analyse the data.

3.7 Classification of Farmers in Ghana by Scale of Production

The Statistical Research and Information Directorate (SRID) of the Ministry of Food and Agriculture (MoFA) have categorized farmers according to the land put under cultivation for the major food crops in Ghana. Farmers with farm sizes below eight (8) hectares are classified as small scale farmers. While those with farm sizes of up to eight (8) hectares (twenty acres) and above said to be large scale or commercial farmers. Following this classification, all the soybean farmers surveyed in the Upper West Region have farm sizes ranging from 0.4 hectare (1 acre) to 4 hectares (10 acres) and therefore fall under the small scale farmers' category. To find out whether farm size has an influence on private and social profitability of soybean production in the region, this study classified the survey sample in to two categories thus farm sizes up to 2 hectares and farm sizes above 2 hectares.

3.8 Overview of Study Area

The Upper West Region of Ghana is located in the north-western corner of the country and is bordered by Burkina Faso to the north, La Cote D'voire to the West, Upper East Region to the east and Northern Region to the south. The region comprises of nine districts (Jirapa, Lambussie-Karni, Lawra, Nadowli, Sissala East, Sissala West, Wa East, Wa Municipal, and Wa West).

It occupies a total land area of 18,476km^2 and inhabited by about 677,763 people (GSS, 2010 and PHC, 2010). The rainfall pattern is mono-modal. The rain falls in a seven-month season from April to October (Blench, 2006). The rainy season permits a growing season of 180–200 days in the region (MoFA, 2011). Mean total annual rainfall varies from 1,000mm to 1,100mm in the region. Mean annual temperature

ranges between 28℃ – 35℃ in the growing season and 22℃ – 40℃ in the off season (MoFA, 2008).

The major economic activity of the region is agriculture. Major crops grown include maize, millet, groundnuts, cowpea, sorghum, soybean, and rice. Livestock such as sheep, goats, poultry, pigs and guinea fowl are raised for meat and eggs. The region is one of the major producers of soybean in Ghana.

CHAPTER FOUR

DISCUSSION OF RESULTS

4.1 Introduction

This section presents and discusses the results of the study. It describes the socio-economic characteristics of soybean farmers in the Upper West Region of Ghana. The chapter answers the research questions which the study sets out to achieve in the order in which they were presented in Chapter One. First of all, it analyses private and social profitability of soybean production in the Upper West Region. Secondly, it measures the transfer effects of government policy on soybean production in the study area. Lastly, it identifies and ranks the constraints to soybean production in the Upper West Region of Ghana.

4.2 Socio-Economic Characteristics of Respondents

Majority (75%) of soybean farmers in the Upper West Region have no formal education. The few (25%) who have attained some formal education, 6.5%, 10.5%, 4.5%, 3.0%, and 0.5% were primary, JHS/Middle School, Secondary/Technical/Vocational School, non-formal education and Tertiary graduates, respectively (Table 4.1). This suggests that most soybean farmers in the region are illiterates. The high illiteracy rate among soybean farmers has the tendency of increasing the cost of production because farmers are not able to read and adopt good agronomic practices. However, comparing these results to earlier findings reported by (GSS, 2002) as cited in (Blench, 2006) the region is faring well in terms of educational statistics. In that study, 83.1%, 10.1%, 3.5%, 2.5% and 0.8% were reported for none, primary, middle, secondary and tertiary levels, respectively. The study also, indicates that majority (88.55%) of soybean farmers are married. Six (6%)

of them are singles, 1% divorced while those remaining (4.5%) are either widows or widowers. This implies that the farmers are responsible. In rural communities where division of labour is normally divided along gender lines, the high marital status of farmers is likely to enhance soybean production. The ages of respondents range between 18 and 82 years, with a mean age of 40 years. This implies that soybean production in Upper West Region is done by both the youth and the aged.

From the table (Table 4.1), the household size of soybean farmers range between 2 and 46 people per household and the mean household size is 11 people per household. This result deviates largely from the national average household size of seven (7) reported by the PHC, 2010 (GSS, 2011).

Table 4.1 Socio-Economic Characteristics of Respondent

Variable	Frequency	Percentage
Education		
Primary	13	6.5
JHS/Middle School	21	10.5
Secondary/Technical/vocational school	9	4.5
Tertiary	1	0.5
None	150	75
Non-formal education	6	3
Total	200	100
Marital status		
Married	177	88.5
Single	12	6.0
Divorced	2	1.0
Widows / Widowers	9	4.5
Total	200	100
Age and Household Size		
Statistic	**Age**	**Household Size**
Minimum	18	2
Maximum	82	46
Mean	40	11.2
Std. Deviation	11.8	1.7
Total number of respondents	200	200

Source: Field Survey, 2012

However, the result is not surprising because the sample that constituted this study was Islam dominant (65.5%) and polygamous marriages are commonly practised. Larger household size is an indication of easy access to family labour which has the tendency of reducing labour cost and increasing private profitability.

4.3 Analysis of Private and Social Profitability of Soybean Production

4.3.1 Private Profitability (Competitiveness) of Soybean Production

The determination of profit actually received by farmers is a straightforward and important initial result of the PAM approach (Ahkter et al., 2007). In the PAM Table, the competitiveness of a system is measured by the private profitability (D) or Private Cost Ratio (PCR). Table 4.2 presents the PAM results, revealing a positive private profit of GH¢3.63/acre. This indicates that soybean production exhibits competitiveness at the farm gate at the current level of technology and prices prevailing at the farm level. This result is reinforced by the PCR of 0.99 (Table 4.3) which is less than unity (1). The positive private profit is expected to lead to future expansion of soybean production, unless the farming area cannot be expanded or substitute crops are more privately profitable. This result is in support of the findings by (Dipokusumo et al., 2003; Aji, 2003) who found positive private profits for soybean in their PAM analysis

Table 4.2: Results of Policy Analysis Matrix for Soybean Production in the UWR

	Revenue	Cost		Profit
		Tradable Input	Domestic Factors	
Private Prices	563.56	131.28	428.65	3.63
Social Prices	673.82	213.11	513.71	-53.00
Divergences	-110.26	-81.83	-85.06	56.63

Source: Appendix VIII & IX

The analysis of private profitability at the districts level in the region shows that all the five districts surveyed with the exception of Wa West district have positive private profits, implying that they are competitive in the production of soybean at farm level at the current level of technology, prices of input and output in the market as well as policy. The Private Cost Ratio (PCR) allows us to rank farming systems from competitiveness point of view. This makes Nadowli District (0.73), Wa Municipal (0.78), Wa East District (0.81), Sissala West (0.81) and Wa West District as the most competitive systems in terms of lowest PCR (Table 4.3). These results however, vary widely from that of earlier studies by (Akhtar et al., 2007) who reported PCR values of 1.14 and 1.41 for Basmati and IRRI rice production systems respectively, in Pakistan's Pujab implying a lack of competitiveness for both systems.

Table 4.3: Competitiveness and Economic Efficiency Indicators for Soybean Production

District/Region	Indicators				
	NPCO	NPCI	EPC	DRC	PCR
Wa Municipal	0.78	0.38	0.97	1.15	0.78
Wa West	0.86	0.23	1.30	1.23	1.04
Wa East	0.80	0.29	0.99	1.01	0.81
Nadowli	1.07	0.48	1.45	1.42	0.73
Sissala West	0.76	0.35	0.96	1.07	0.81
Regional	0.84	0.62	0.94	1.11	0.99

Source: Appendix V

4.3.2 Social Profitability (Comparative Advantage) of Soybean Production in Upper West Region

A negative social profit of GH¢ -53/acre is obtained for soybean production system as indicated in the second row of the PAM table. This implies that the production system uses domestic resources inefficiently, and hence lacks comparative advantage.

The ratio used to measure comparative advantage is the Domestic Resource Cost (DRC). The DRC for the soybean system in the Upper West Region is 1.11(Table 4.3). This indicates that the region has no comparative advantage in soybean production. This result is partly in support of initial results by (Akhtar et al., 2007), their DRC values recorded 0.56 and 1.20 for Basmati and IRRI rice systems respectively, indicating a comparative advantage for Basmati rice and a comparative disadvantage for the IRRI system. The results do not also support those of (Jierwriyapant and Hadi, 1991) who found soybean production to be efficient but not competitive in Chiang Mai Province, Pakistan.

Also, all the five districts surveyed in the region record ($DRC > 1$), (Table 4.3), which means that none of the districts has comparative advantage in the production of soybean. This suggests that Upper West soybean industry cannot survive without government support. The DRC also allows us to rank commodity systems from efficiency point of view. Thus from Table 4.3, Wa East, Sissala West, Wa Municipal, Wa West and Nadowli district even though not efficient are ranked according to their relative efficiency levels in terms of lowest DRC.

4.4 Transfer Effects of Government Policy on Soybean Production

4.4.1 Output Transfers in Soybean Production in the Upper West Region, 2011

The most important transfers occur in terms of revenue for every commodity system. The results in Table 4.4 show a divergence of GH¢-110.26. This implies that soybean farmers received about GH¢110.26/acre less than the prevailing world price of soybean. This is indicative of a substantial implicit tax on soybean operators. The amount also represents savings to society and can be interpreted as transfer from

soybean farmers to society. The ratio used to measure output transfers is called the Nominal Protection Coefficient on Output (NPCO). The NPCO for the soybean system is less than 1 (0.84), which further, buttresses the point that soybean farmers received lower prices than they would have received facing world prices. This findings support (Ogbe et al., 2011) results in Nigeria that outputs from rice and maize systems were taxed. It also confirms the findings of (Akhtar et al., 2007) that rice farming systems received lower prices than the prevailing world (parity) prices.

Table 4.4: Output Transfer in Soybean Production in the Upper West Region

	Revenue(GH¢**/Acre)**
Private Prices	563.56
Social Prices	673.82
Divergence	-110.26

Source: Appendix IV

From Appendix IV, all the districts studied with the exception of Nadowli, show a negative divergence between private and social revenue. In Nadowli district, farmers received as much as GHS 44/acre more than the world price of soybean, indicating a transfer from society to soybean operators. In the remaining districts, farmers received GH¢143.23, GH¢76, GH¢153.51, and GH¢155.86 less than the world price in Wa Municipal, Wa West, Wa East and Sissala West, respectively. In these districts an implicit tax has been imposed on farmers. The amounts indicate savings to society and can be said to be transfers from soybean farmers to society. All the districts with the exception of Nadowli have($NPCO < 1$)Table 4.3.

4.4.2 Tradable Input Transfers of Soybean Production

The Nominal Protection Coefficient on Input (NPCI) for the soybean production is less than 1 (0.62) (Table 4.5). This suggests that the policy regime favours farmers and reduces the cost of tradable inputs to some extent. It implies that soybean production was slightly subsidized by policy on tradable inputs. This result is reinforced by the negative inputs transfer of GH¢ 81.83/acre.

Table 4.5: Tradable Input Transfers of Soybean Production in Upper West Region

	Tradable Input Costs			Total	NPCI
	Fertilizer	Seed	Chemical		
Private Price	101.8	13.96	15.52	131.28	0.62
Social Price	188.83	12.49	11.79	213.11	
Divergence	-87.03	1.47	3.73	-81.83	

Source: Appendix IV

The government's subsidy on fertilizer caused the per acre market price of fertilizer (GH¢101.8) to be lower than the efficient price (GH¢188.83) as revealed by the private and social prices, respectively of fertilizer in Table 4.5. Technically, this represents a transfer from the government to soybean operators and hence, a loss to society in general. Even though there are transfers on seed and chemical, the transfer on fertilizer is the most significant and hence the one most affected by policy on the soybean production system. The results at the districts is not significantly different from those portrayed for the region as a whole since all the districts have $(NPCI < 1)(see\ Table\ 4.3)$. These results are in support of initial findings by (Akhtar et al., 2007) whose PAM analysis revealed NPCI values of 0.94 and 0.87 for Basmati and IRRI rice systems, respectively. This result is consistent with that of (Ogbe et al., 2011) whose results found significant subsidies on tradable input.

4.4.3 Domestic Factor Transfers of Soybean Production

Domestic factors include: labour, capital, and land. Because no divergences were observed in the markets for labour (Table 4.6), the private and social costs of labour are assumed to be identical. The social opportunity cost of land planted to soybean (GH¢201.84/acre) is quite higher than the private land rental rate (GH¢156.43/acre) (Table 4.6). The social prices for land are estimated by calculating the social profits of the land planted to the next best alternative crop (Pearson et al., 2003). But the land rental market works imperfectly, reflecting a lack of information.

Table 4.6: Domestic Factor Transfers of Soybean Production in Upper West Region

	Domestic Factor Transfer			Total
	Labour	Capital	Land	
Private Price	140	132.22	156.43	428.65
Social Price	140	171.89	200.13	513.71
Divergence	0	-39.67	-43.7	-85.06

Source: Appendix IV

The wedge between the private and social prices of land is also attributed to the poor development of the agricultural land market in the Upper West Region. It was therefore, not surprising that most respondents could not quote an observed market price for land. As a result, the most significant transfer in domestic factors occurred in the land sector (GH¢-43.70/acre) (Table 4.6). The private price of capital was adjusted by the prevailing lending rate (30%) in the base year of the study to arrive at the efficient interest rate (see Appendix VI).

4.4.4 Net Transfers in Soybean Production

Net transfers provide a summary of the effect of government policies or market failures on commodity systems (Msi, 2003). From Table 4.7, the positive net transfer of GH¢56.63/acre indicates that incentive policies are being implemented. This suggests that overall, government policy provided incentives for farmers to produce soybean in the Upper West Region. Alternatively, the result indicates that the net effect of government policy on both the inputs and output markets will result in positive social benefit. The Effective Protection Coefficient (EPC) shows the joint effect of policy transfers affecting both tradable inputs and tradable outputs. It also, measures the degree of policy transfer from product market policies (Seini, 2002). The EPC for soybean production system is less than unity 1(0.94) (Table 4.3), in addition, Wa Municipal, Wa East, and Nadowli districts have EPC values less than one. However, Wa West and Sissala West districts have EPC values greater than one. For the systems in which the EPC is less than one, implies that they are disprotected by policy on value added. While systems with EPC greater than one implies that they are protected by policy on value added.

Table 4.7: Net Transfers in Soybean production in Upper West Region

	Profit
Private Prices	3.63
Social Prices	-51. 31
Divergences	54.94

Source: Appendix IV

4.5 Analysis of private and social profitability of Soybean Farming Systems

4.5.1 Analysis of Private Profitability

Private profitability indicates the short to medium-term financial viability of the commodity system from the producer's perspective and suggests the extent to which the system may attract further investment (Seini, 2004). The PAM results presented in Appendix XII reveal a positive private profit of GH¢ 47.58/acre and GH¢ 84.79/acre for both small Scale (farm sizes ≤ 5acres) and large scale (farm sizes > 5acres) soybean producers respectively. This implies that both systems are earning supernormal rate of returns at the current level of technology, prices of inputs and output as well as policy, hence operators are likely to increase the production of the commodity. Entrepreneurs in a system prefer to earn excess profits and they achieve this result if their private factor costs are less than their value added in private prices. The PCR is less than unity (0.90 and 0.81) (Table 4.8) for both small (farm sizes ≤ 5acres) and large scale (farm sizes > 5acres) soybean production systems respectively, thus buttressing the competitiveness of both systems at the farm level.

Table 4.8: Competitiveness and Efficiency Indicators of Soybean Farming Systems in UWR.

Farming System	Indicator				
	NPCO	NPCI	EPC	DRC	PCR
Small Scale(farm sizes ≤ 5acres)	0.84	0.35	1.06	1.28	0.90
Large Scale (farm sizes >5acres)	0.80	0.35	1.03	0.99	0.81

Source: Appendix XI

4.5.2 Analysis of Social Profitability

The results show a negative social profit (GH¢-128.28/acre) for the small scale system but a positive social profit (GH¢31.78) for the large scale system (Appendix XII). Also, the computed DRC which is a proxy measure of comparative advantage is greater than one (1.28) for the small scale system but less than unity (0.99) for the large scale system (farm sizes > 5acres) (Table 4.8). These imply that the small scale system uses resources inefficiently, hence lacks comparative advantage in the production of soybean in the region. This also, means that for small scale farmers in the Upper West Region in the 2011 production year, it costs less to the nation to import soybean than produce it in the region. However, the large scale soybean production system in the region uses resources efficiently and can be said to possess a comparative advantage in the production of soybean.

4.5.3 Analysis of Transfers

The output transfer which is the difference between private and social revenues and used to infer the direction of policy impact are negative for both soybean systems as given in Appendix XII. Entrepreneurs in the system received prices as much as GH¢-107.42/acre lower than efficiency prices for the small scale system and GH¢-131.56 lower than the world price for the large scale system (Appendix XII). This implies that the production system is implicitly taxed or resources are being transferred away from the system. From Table 4.8, an NPCO values of 0.84 and 0.80 for small and large scale farmers respectively, go to reinforce the position that soybean farmers received low prices for their output than they would have received if their output was valued at the world prices. Similarly, an NPCI values of 0.35 and 0.35 which are both less than one for the small and large scale systems respectively, implies that policies are reducing input costs making them less costly compared to their world prices. In

both systems the fertilizer subsidy which is the main policy is making tradable input cost an average of 35% and 35% of their world prices.

Divergences in factor markets results from both market failures and distorting policies. The results in this study indicate that small and large scale farmers have negative transfers implying an implicit subsidy or transfer of resources in favour of the agricultural system.

The effective protection coefficient (EPC) measures the degree of policy transfer from product market policies and is the value added in private prices to the value added in world prices (Seini, 2002; Monke and Pearson, 1989 and Pearson et al., 2003). The EPC is greater than unity (1.06 and 1.03) for small and large scale systems, respectively (Table 4.8). The implication is that the two systems enjoy a lot of protection on tradable inputs employed by operators in the system. However, it should be noted that the EPC, like its NPC counterpart does not incorporate the transfer effects of factor market policies, hence it is an incomplete indicator of incentives.

4.6 Constraints to Soybean Production in the Upper West Region

The factors that limit soybean production in the region were identified from literature. These constraints, in order of importance, are water stress, inadequate access to credit facilities, limited access to tractor services, low output price, inadequate supply of modern inputs, ignorance of improved production methods, lack of threshers and dryers, pest infestation, inadequate extension campaign, limited market access, and little information about soybean agronomic practices. Two hundred (200) soybean

farmers across the region were asked to rank these constraints in a scale of 1 to 11. Table 4.9 contains the constraints specifying the rankings of respondents.

From Table 4, water stress has the highest ranking and therefore is the most pressing constraint to soybean production in the Upper West Region. This is attributed to the fact that agricultural production in Ghana in general and the Upper West Region in particular is primarily rainfed, making food crop production subject to the uncertainties associated with weather conditions (Blench, 2006; MoFA, 2010). The rainfall pattern in the region over the years has been unpredictable and irregular to the extent that sometimes farmers, for fear of rain failure may want to plant earlier or later than usual resulting in poor harvest. This result is in support of earlier findings by Kahair et al., (2003) that water stress was a major technical constraint in soybean production in Upland Balochistan. Similarly, the result is also consistent with earlier findings in Ghana that erratic and unpredictable rainfall (often leading to periods of drought) is a major constraint to increased soybean productivity (Dapaah et al., 2005).

Table 4.9: Constraints to Soybean Production in the Upper West Region

Constraint	Mean Rank	Rankings
Water Stress	2.48	1
Inadequate access to credit facilities	3.89	2
Limited access to tractor services	3.91	3
Low output price	4.65	4
Inadequate supply of modern inputs	5.20	5
Ignorance of improved production methods	6.29	6
Lack of threshers and dryers	6.81	7
Pest infestation	7.64	8
Inadequate extension campaign	7.86	9
Limited market access	8.05	10
Little information about soybean agronomic practices	9.22	11

Source: Field Survey, 2012.

The next most limiting factor to soybean production in the region is limited access to credit facilities. Soybean farmers often find it difficult to access credit to expand their scale of production. Much of the credit that was advanced to farmers came from Non-Governmental Organizations (NGOs) and private individuals. Farmers often find it difficult to access credit from formal credit institutions because agriculture is often viewed by banks as a risky business and farmers find it difficult to meet the high collateral security and interest rate requirements of these banks. On the other hand, private companies that advanced credit to farmers operated to their own benefit and not the farmers, because these companies tend to exploit the farmers by buying their produce at lower prices making the farmers worse off. The credit situation is so serious to the extent that in some communities where farmers who were originally beneficiaries of the NGO credit stopped production when the NGOs withdrew their support systems. Early studies by Kahair et al., (2003) and Olomola, (2007) also identified credit as a major constraint.

Limited access to tractor services is the third most important obstacle to soybean production in the Upper West Region. Most respondents (90%) held the view that even when they get early rains getting access to tractor to plough their lands early is always hectic. This is attributed to the fact that very few farmers (10%) own tractors, and tractor operators normally tend to favour farmers with larger acreages than smaller ones who form the bulk of the farming community (Sanginga et al., 1999). Farmers normally form long queues to access the services of the few available tractors. The other reason is that tractor operators often capitalize on the supply demand situation to charge as much as GH¢45.00 (US$23.68)/acre in most cases. The net result of this is the inability of farmers to access tractor services on timely basis.

The fourth most limiting factor to soybean production is low output price. Most farmers claimed that despite the difficulties involved in the production of soybean, the market does not offer them good price to offset the challenges they go through. This result confirms earlier findings by Plahar (2006), Kahair et al., (2003) and Olomola (2007).

Limited supply of modern inputs (fertilizer, chemicals, threshers and dryers, etc) is yet another obstacle to soybean production. Even though government has subsidized the price of fertilizer to make them accessible to farmers, some farmers still claimed they could not access it due to financial constraint. Modern inputs such as threshers and dryers, among others are very limited in supply and farmers in most instances have to form long queues to access their services where possible. In the case of threshers and dryers, Farmers complained that it is difficult threshing soybean manually but they lack the requisite machines to thresh and dry their produce. The threshing constraint is so difficult to the extent that some farmers have limited their acreages to an average of 2 acres.

The sixth most pressing constraint to soybean production is ignorance of improved production methods. The problem is so serious to the extent that most respondents (65%) continue to cultivate the traditional low yielding variety (Anedaso) that shatters so much even though SARI has been able to develop a high yielding non-shattering variety (Jenguma) that is present in the market. Most farmers were ignorant about the

existence of the new variety. The high level of ignorance among soybean farmers is attributed to the high (75%) illiteracy rate among soybean farmers in the Upper West Region. Olomola (2007) in his study of the Competitive Commercial Agriculture in Africa (CCAA), identified ignorance of improved production methods among farmers as one of the major constraints to soybean production in Nigeria.

Besides the constraints enumerated above, farmers also have to grapple with the problem of pest infestation. Farmers have to incur some extra costs on pest control. This according to them increases their production costs and hence limits their profit. However, all farmers in the study area do not share this opinion. This result is consistent with an earlier result by Quang-Hanh et al., (undated) which indicates that Pest infestation was a major constraint in increasing production in the intensive soybean crop in Ha-bac, Ha-noi-binch, and Vinh-phu, where the bean fly (meanagromyza sojae) destroyed 30% to 80% of soybean plants.

Apart from the low output price of soybeans as earlier stated, farmers also find it difficult getting market to dispose their soybean. This according to the farmers is partly due to the limited integration of soybeans into household dishes in the study area. Apart from dawadawa and local tom brown preparation, most households do not know other alternative uses of soybeans despite the vigorous campaigns on utilization technologies by MoFA and ADRA (Daaku and Mensah, 2006; Plazar, 2003, 2006; Otoo, 2008; WISHH, 2006). The major market outlets available to the farmers are: Upper West Agro Industry Limited and Savannah Marketing Company Limited. These companies buy soybean for use in their industrial operations. The other buyers

are the market women and households who buy in smaller quantities. The limited market access as found by this study is consistent with the results of earlier studies that access to local market is a major constraint to soybean production in developing countries in both the tropics and sub-tropic (FAO, 2003; 2005).

Inadequate extension campaign is not spared when it comes to soybean production in the Upper West Region. Even though farmers acknowledged that they have had some contacts with extension personnel, they are of the opinion that extension campaign was not adequate enough. They attributed the low extension campaign to limited extension officers in the region as a whole and poor motivation of the few officers to go into the hinterlands where majority of the farmers are located.

The least constraint to soybean production in Upper West Region is little information about soybean agronomic practices. As a consequence of the inadequate extension campaign some farmers do not have adequate knowledge about soybean production. Soybean production requires proper crop care to attain maximum yield.

5.6.1 Validation of Hypothesis

The Kendall's Coefficient of Concordance (W) was used to test the following hypothesis:

H_0: There is no agreement among soybean farmers regarding the rankings of constraints to soybean production in the Upper West Region.

H_1: There is agreement among soybean farmers regarding the rankings of constraints to soybean production in the Upper West Region.

The information provided in Table 4.10, shows that the F-statistic calculated (138.29) is greater than the F-critical (2.33) at 1% level of significance. Therefore the null hypothesis is rejected in favour of the alternative hypothesis. The implication is that there is agreement among soybean farmers regarding the rankings of constraints to soybean production in the Upper West Region.

Table 4.10: Results for the Test Statistics on Kendall's coefficient of concordance

Statistic	Value
N	200
Kendall's W[a]	0.410
Chi-Square	820.318
Df	10
Asymp. Sig.	0.000
F statistic calculated	138.29
F critical(0.01, 9.99, 1988.01)	2.33

Source: Field Survey, 2012

4.7 Sensitivity Analysis

As the PAM is a static model which cannot capture the potential changes in prices and productivity, these results are subject to change with market conditions. For example, changes in either international prices or parity prices of tradable inputs can change the values of DRC and PCR. The sensitivity analysis illustrates how the PCR and DRC ratios for soybean production react to various parameter changes and how soybean yield and price changes can alter the PCR and DRC ratios. Based on the PAM results presented in Table 4.2 and assuming that is the real situation of these parameters in Upper West Region. Table 4.10 shows what the changes in the PCR and DRC ratios would be if the productivity and price parameters were decrease by 5%, 10%, 15% and 20%.

From Table 4.11, if soybean yield decrease by 5%, 10%, 15% and 20%, soybean production will not be competitive in the Upper West Region. Similarly, if prices of soybean were to decrease by 5%, 10%, 15% and 20% the soybean system will still not be privately profitable. With regards to efficiency, if soybean yield or prices decrease by 5%, 10%, 15% and 20%, the soybean system will still be at a comparative disadvantage.

Table 4.11: Sensitivity Analysis by changing the Soybean Yield or Price

Change Scenario	Yield		Price	
	DRC	PCR	DRC	PRC
Base scenario	1.11	0.99	1.11	0.99
-20%	1.20	1.06	1.20	1.06
-15%	1.31	1.14	1.31	1.14
-10%	1.43	1.23	1.43	1.23
-5%	1.57	1.34	1.57	1.34

Source: Field Survey, 2012

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This part of the report states the implications of the findings of the research and the extent to which the findings contribute to the understanding of the competitiveness of soybean production in the Upper West Region of Ghana. Based on these findings, the chapter makes some functional policy recommendations.

5.2 Summary

This study has assessed the competitiveness of soybean production in the Upper West Region of Ghana using the Policy Analysis Matrix approach. The study specifically analysed private and social profitability of soybean production and measures the transfers' effects of government policy on the production system. The constraints to soybean production in the region were also identified and ranked.

The findings indicate that soybean production in the Upper West Region is competitive at the farm level at the current level of technology and prevailing prices as evidenced by a positive private profit and Private Cost Ratio (PCR) of less than unity. The positive private profit is expected to serve as an incentive for soybean farmers to continue and expand the production of the crop unless the farming area cannot be expanded and/or substitute crops are more privately profitable. However, with regards to efficiency, the results reveal that soybean production in the Upper West Region exhibits lack of economic efficiency in the use of scarce domestic resources as demonstrated by a negative social profit and a Domestic Resource Cost (DRC) ratio of greater than unity.

The analysis of the policy transfers reveals negative transfers for output, tradable inputs and domestic factors of production. It however, shows an overall positive net policy effect for the soybean system. The negative output transfer as exhibited by a less than unity Nominal Protection Coefficient on Output (NPCO) implies that farmers receive prices lower than they would have received facing world prices. This finding suggests an implicit tax on soybean operators. On the input side, the result reveals that the system is been subsidized by policy on tradable inputs. This reduces production costs to an extent than it would have happened in the absence of policy. The negative factor transfer is mainly caused by a cheaper land rent than the social price. The study attributes the divergence between the private and the social opportunity cost of land to the poor development of rural land market to provide competitive outcomes. The same can be said about the capital market. However, no divergence is observed in rural labour market, so the private wage rate is used as a good approximation of the social wage rate. Major constraints to soybean production in the Upper West Region in order of importance include water stress, inadequate access to credit facilities and limited access to tractor services.

Sensitivity results demonstrate that if soybean yield or price decrease by 5%, 10%, 15% and 20%, soybean production in the Upper West Region will be privately and socially unprofitable.

5.3 Conclusions

Positive private profit is expected to motivate farmers to expand the production of the crop, provided land is available and substitute crops are not more privately profitable.

Negative social profit implies that the soybean industry cannot survive without government support.

A positive net policy transfer means that overall, government policy provides incentives for operators to produce soybean. It also implies that the net effect of policy in the input and output markets will result in positive social benefits. A negative input transfer suggests that the policy regime favours farmers and reduces the cost of tradable inputs to some extent-soybean production was slightly subsidized by policy on tradable inputs. The divergence between the private and social prices of land and capital show the inherent poor development of the capital and agricultural land markets in the Upper West Region. Water stress, inadequate access to credit facilities and limited market access are identified and ranked as the major constraints facing growers of soybean in the region.

5.4 Recommendations

Based on the results of the study and the conclusions made, some important policy recommendations emerge for the Upper West soybean industry.

- Since the soybean production system records a negative social profit it implies that government will have to continue to provide support systems in the form of subsidies to inputs if the objective of the government is to raise farmer's income or ensure food security (a promotion of non-efficiency objective for that matter). The subsidy of fertilizer in particular will have to be extended to include the development and dissemination of the new seed variety (Jenguma) developed by SARI at a subsidised price to serve as incentives for farmers to grow the crop.

- Since the results reveal a poor development of rural institutions especially in the lack and financial sectors, government should promulgate appropriate policies that will facilitate the development of rural institutions particularly the financial and land sectors to enable them provide efficient services.
- Water stress has been identified and ranked as the main constraints to growers of soybean, the government through MoFA should take proactive measures to provide irrigation facilities to solve the problem of water stress through irrigation. The irrigation package should target small scale irrigation infrastructure. Since the farmers are largely small holder farmers and illiterates they may not be able to manage sophisticated irrigation facilities.
- Since limited access to credit facilities is also a major constraint, government should liaise with banks especially the Agricultural Development Bank to give credit facilities to farmers at reasonable interest rate and minimal collateral requirement.
- The third most pressing constraint identified is limited access to tractor services. Government should set up tractor centres in all districts across the region where farmers can go to rent tractor services at subsidised prices. This will break the monopoly of the few tractor owners and increase access to tractor services on timely basis.
- On the issue of the low output price government should set up a buffer stock and provide a guaranteed minimum price for soybean. This could break the monopoly of Upper West Agro-Industries Limited and Savannah Marketing Company Limited and also solve the challenge of limited market access.

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APPENDICES

APPENDIX I: QUESTIONNAIRE

The competitiveness of soybean production in the Upper West Region of Ghana

This questionnaire is to solicit information for academic (M.Phil. Agribusiness Thesis) purpose only and hence will be held ***confidential***

Code _____

District _____ **Community** _____

Name of Interviewer _____ **Date** _____

Section A: Background Information

1. Name of respondent _____
2. Sex of respondent. a) Male [ ] b) Female [ ]
3. Age of respondent _____
4. Primary occupation of respondent. a) Farming**[ ]** b) Trading **[ ]** c) Processing **[ ]** d) Government work **[ ]** e) NGO work f) Other (specify) _____
5. Educational level of respondent. a) Primary **[ ]** b) JHS/Middle School **[ ]** c) Secondary/Technical/Vocational **[ ]** d) Tertiary **[ ]** e) Other (specify) _____
6. Religious affiliation of respondent. a) Christianity **[ ]** b**)** Islam **[ ]** c) ATR **[ ]** 4) Other (specify) _____
7. Marital status of respondent 1) Married**[ ]** a) Single**[ ]** b) Separated **[ ]** c) Divorced **[ ]** e) Other (specify) _____
8. Ethnicity a) Dagao b) Waluu c)Sissala d) Other (specify) _____
9. Household size a) Adults **[ ]** b) Children **[ ]** Total ☐
10. How many acres of land did you cultivate last year? _____
11. Which variety of soybean did you plant in the last crop season? A) Jenguma**[ ]** b) Quarshie **[ ]** c) Anedaso **[ ]** d) Sylintua 1 **[ ]** e) Sylintua 2 **[ ]**

12. Are you a member of one of a block farm groups? a) Yes **[**] b) No **[**]
13. If yes, provide name of group where applicable, and indicate the number of members in your group _____
14. If no, why? _____
15. Did you apply fertilizer to your soybeans last year? a) Yes **[**] b) No **[**]
16. If yes, which of these fertilizers did you use? a)NPK (15-15-15) **[**] b) Sulphate of Ammonia**[**] c) Urea **[**] d)NPK (Actyva) **[**] e) Sulfan
17. If no, give reason(s) _____

Section B: Analysis of Private and Social Profitability

Valuation in Private (Observed Market) Prices

18 Please indicate in the table below the rate of use of each of these inputs where applicable and their respective prices for the 2011 farming season.

Materials	**Quantity**	**price**
NPK 15: 15: 15		
23: 10: 5 (Actyva)		
Sulphate of Ammonia		
Urea		
Sulfan		
Liquid pesticide		
Granulated pesticide		
Seed		
Fuel		
Capital		
Working capital		
Tractor services		
Thresher		

19. How much did you spend on acquiring an acre of land? _____
20. What was the total output (bags) of soybean obtained last year? _____
21. What was the selling price of a bag of soybean last year? _____
22. Do you store your produce? a) Yes **[** **]** b) No **[** **]**

23. Indicate the cost incurred in carrying out the following activities on your soybean

Farm last year

Activity	Type of labour	No of workers			Number days worked			Rate (GH¢)
		M	F	C	M	F	C	
Ploughing/land preparation								
Planting								
Fertilizer application								
Weeding								
Harvesting								
Threshing /winnowing								
Drying / bagging								
Total cost of labour(GH¢**)**								

NOTE: M=Adult Male, F= Adult Female, C=Children

24. If yes, how much did you spend on storage of your produce? _____

25. If no give reason(s) _____

26. Where do you sell your produce? a) Farm gate **[ ]** b) retail market **[ ]**

c) Wholesale market **[ ]**

27. How much does it cost you to transport a bag of soybean to the market/processing Centre (including fare and charge for carriage of goods)? _____

Valuation in Social (Efficiency) Prices

28. Which of these crops would you have cultivated on your farm land if it was not planted to soybean? 1) Maize **[ ]** 2) groundnuts **[ ]** 3) millet **[ ]** 4) rice **[ ]** 5) yam **[ ]** 6) sorghum **[ ]** 7) other, specify _____

29. Indicate the rate of use of these inputs for the best alternative crop and their respective prices for 2011 crop season

Materials	**Quantity**	**Price (**GH¢)
NPK 15: 15: 15		
23: 10: 5 (Actyva)		
Sulphate of Ammonia		
Urea		
Liquid pesticide		
Granulated pesticide		
Seed		
Capital		
Working capital		
Tractor services		
Thresher		

Output(bags)	

30. Indicate the against each activity the cost of labour incurred in carrying out the activity

Activity	Type of labour	No of workers			Number days worked			Rate (GH¢)
		M	F	C	M	F	C	
Ploughing/land preparation								
Planting								
Fertilizer application								
Weeding								
Harvesting								
Threshing /winnowing								
Drying / bagging								
Total cost of labour(GH¢**)**								

Section C: Distorting government policies and market failures

31. Do you get access to credit? a) Yes [**]** b) No **[ ]**

32. If yes, indicate by ticking the sources from which credit was obtained and indicate the amount of credit that was received from each source.

Number	Source of Credit	Tick	Form of credit 1= Cash 2= In kind	Interest Rate	Amount Received
1	Farm household savings				
2	Formal credit market institutions(commercial bank etc)				
3	Agro-input dealers				
4	Local-money lenders				
5	NGO				
6	Other,(specify)				
Total credit received in (GH¢)					

33. Do you receive any subsidised credit from the government/MoFA? a) Yes **[ ]** b) No **[ ]**

34. If yes, what form of subsidised credit did you receive?_____

35. If no, give reason(s)_____

36. Do you get access to fertilizer subsidy? a) Yes **[ ]** b) No **[ ]**

37. If yes, what was the amount of the subsidy obtained? _____

38. Are there any financial institutions operating in your locality? a) Yes **[ ]** b) No **[ ]**

39. If yes, list them. _____

_____

_____

_____

40. If no, why _____

_____

41. Are there situations where all farmers in your locality buy fertilizer from the same seller? A) Yes [ ] b) No [ ]

42. If yes, name the seller _____

43. Who buys your soybeans? _____

44. Do you easily get access to hired labour when the need arises? A) Yes **[ ]** B) No **[ ]**

45. If yes how? _____

46. If no, why? _____

Section D: Constraints

47. Please rank the following constraints you face from the most pressing to the least pressing. *Where **1** being the most pressing and **10** being the least pressing constraint.*

Number	Constraint	1= Yes 2= No	Rank
1	Limited market access		
2	Low output price		
3	Inadequate access to credit facilities		
4	Ignorance of improved production methods		
5	Lack of threshers and dryers		
6	Inadequate extension campaign		
7	Inadequate supply of modern inputs		
8	Pest infestation		
9	Water stress		
10	Little information about soybean agronomic practices		
11	In adequate access to tractor services		

General Observation

_____

_____

_____

_____

_____

Thank you

APPENDIX II

SUMMARY STATISTICS OF HOUSE HOLD CHARACTERISTICS

IIa: Occupation of Respondents

occupation	Frequency	Percent
Farming	191	86.5
Trading	2	1.0
Processing	1	0.5
Government Work	3	1.5
Other	3	1.5
Total	200	100.0

Source: Field Survey, 2012

II b: Religious Affiliation of Respondents

religion	Frequency	Percent
Christianity	53	26.5
Islam	131	65.5
ATR	16	8.0
Total	200	100.0

Source: Field Survey, 2012

II c: Ethnicity of respondents

Ethnicity	Frequency	Percent
Dagao	51	25.5
Waluu	86	43.0
Sissala	40	20.0
Dorimuu	4	2.0
Other (specify)	19	9.5
Total	200	100.0

Source: Field Survey, 2012

II d: Soybean Variety

Variety	Frequency	Percent
Jenguma	70	35
Anedaso	117	58.5
Quarshie	2	1.0
Sylintuah 1	10	5.0
Sylintuah2	1	.5
Total	200	100

Source: Field Survey, 2012

II e: Access to Hired Labour

Response	Frequency	Percent
No	94	47.0
Yes	106	53.0
Total	200	100.0

Source: Field Survey, 2012

II f: Financial Institutions Availability

Response	Frequency	Percent
No	117	58.5
Yes	83	41.5
Total	200	100.0

Source: Field Survey, 2012

II g: Type of Market Accessed by Farmers

Type of market	Frequency	Percent
farm gate	100	50.0
retail market	38	19.0
wholesale market	62	31.0
Total	200	100.0

Source: Field Survey, 2012

II h: Monopoly in Fertilizer Market

Response	Frequency	Percent
No	155	77.5
Yes	45	22.5
Total	200	100.0

Source: Field Survey, 2012

II i: Source of credit

Source	Frequency	Percent
None	141	70.5
Farm household savings	1	0.5
Formal credit market	11	5.5
Agro-input Dealers	1	0.5
NGO	21	10.5
Private individuals	25	12.5
Total	200	100.0

Appendix III: Import/World Prices of Soybean, Fertilizer and Insecticides In GH¢/KG

PRODUCT	YEAR						GH¢/KG
	2009		2010		2011		
	custom value(GH¢)	net weight (KG)	custom value(GH¢)	net weight(KG)	custom value(GH¢)	net weight(KG)	
Soya beans	47,365.81	197,864.90	32,490.37	169,136.14	99,749.61	109,247.50	0.9131
Nitrates of potassium	230,144.61	44,884.55	251,279.16	99,331.51	263,259.11	157,392.54	1.6726
Urea	4,299,707.92	8,894,917.46	7,863,698.22	14,025,366.53	8,339,825.91	12,363,025.91	0.6746
Ammonium sulphate	4,259,888.47	14,050,868.84	10,948,374.52	32,965,292.00	19,939,698.25	46,222,685.37	0.4314
Insecticides,	1,954,354.61	647,235.75	1,127,063.68	559,218.85	2,870,243.27	505,930.04	5.6732

Source: Ghana Statistical Service (GSS,Trade Division), 2012

Note: Computation of social prices from this data was done based on the base year (2011) figures

Appendix IV: PAM Results for Soybean Production in Upper West Region by Districts

	Revenue	Cost								Profit
		Tradable Input				Domestic Factors				
		Fertilizer	Seed	Chemicals	Total	Labour	Land	Capital	Total	
Wa Municipality										
Private Prices	518.22	58.78	13.62	6.73	79.13	124.78	156.43	60.46	341.67	97.42
Social Prices	661.45	188.83	14.78	5.67	209.28	124.78	318.3	78.6	521.68	-69.51
Divergences	-143.23	-130.05	-1.16	1.06	-130.15	0	-161.87	-18.14	-180.01	166.93
Wa West District										
Private Prices	487.28	31.77	9.96	10	51.73	205.91	156.43	88.7	451.04	-15.49
Social Prices	563.94	188.83	10.79	28.35	227.97	205.91	100.48	107.31	413.7	-77.73
Divergences	-76.66	-157.06	-0.83	-18.35	-176.24	0	55.95	-18.61	37.34	62.24
Wa East District										
Private Prices	620.17	38.14	12.85	8.92	59.91	116.61	156.43	181.96	455	105.26
Social Prices	773.68	188.83	12.41	6.21	207.45	116.61	217.78	236.54	570.93	-4.7
Divergences	-153.51	-150.69	0.44	2.71	-147.54	0	-61.35	-54.58	-115.93	109.96
Nadowli District										
Private Prices	645.39	56.71	14.99	40.1	111.8	128.07	156.43	103.95	388.45	145.14
Social Prices	601.39	188.83	12.79	32.51	234.13	128.07	257.97	135.14	521.18	-153.92
Divergences	44	-132.12	2.2	7.59	-122.33	0	-101.54	-31.19	-132.73	299.06
Sissala West District										
Private Prices	486.49	48.82	18.7	5.93	73.45	156.05	156.43	38.32	350.8	62.24
Social Prices	642.35	188.83	16.01	6.08	210.92	156.05	253.9	49.81	459.76	-28.33
Divergences	-155.86	-140.01	2.69	-0.15	-137.47	0	-97.47	-11.49	-108.96	90.57
Upper West Region as a whole										
Private Prices	563.56	101.8	13.96	15.52	131.28	140	156.43	132.22	428.65	3.63

Social Prices	673.82	188.83	12.49	11.79	213.11	140	200.13	171.89	512.02	-51.31
Divergences	-110.26	-87.03	1.47	3.73	-81.83	0	-43.7	-39.67	-83.37	54.94

Source: Computed from Field Data, 2012 and Ghana Statistical Service Data, 2012

Appendix V: Estimation of Competitiveness and Economic Efficiency Indicators

Appendix VA: Upper West Region Competitiveness and Economic Efficiency Indicators

Indicator	Formulae	Computation	Results
Nominal Coefficient on Output (NPCO)	$NPCO = \frac{A}{E} = \frac{(P_{id} * Q_i)}{(P_{ib} * Q_i)}$	$NPCO = \frac{A}{E} = \frac{563.56}{673.82} = 0.84$	0.84
Nominal Protection Coefficient on Input (NPCI)	$NPCI = \frac{B}{F} = \frac{(P_{jd} * X_j)}{(P_{jb} * X_j)}$	$NPCI = \frac{B}{F} = \frac{131.28}{213.11} = 0.62$	0.62
Effective Protection Rate (EPC)	$EPC = \frac{A-B}{E-F} = \frac{(P_{id} * Q_i) - (P_{jd} * X_j)}{(P_{ib} * Q_i) - (P_{jb} * X_j)}$	$EPC = \frac{A-B}{E-F} = \frac{563.56 - 131.28}{673.82 - 213.11} = \frac{432.28}{460.71} = 0.94$	0.94
Domestic Resource Cost (DRC)	$DRC = \frac{G}{(E-F)} = \frac{(P_{ns} * Q_n)}{\{(P_{ib} * Q_i) - (P_{jb} * Q_j)\}}$	$DRC = \frac{G}{E-F} = \frac{512.02}{673.82 - 213.11} = \frac{512.02}{460.71} = 1.11$	1.11
Private Cost Ratio (PCR)	$PCR = \frac{C}{A-B} = \frac{(P_{nd} * X_n)}{(P_{id} * Q_i) - (P_{jd} * X_j)}$	$PCR = \frac{C}{A-B} = \frac{428.65}{563.56 - 131.28} = \frac{428.65}{432.28} = 0.99$	0.99

Source: Computed from PAM Results (Appendix IV)

Appendix VB: Wa Municipal Competitiveness and Economic Efficiency Indicators

Indicator	Formulae	Computation	Results
Nominal Coefficient on Output (NPCO)	$NPCO = \frac{A}{E} = \frac{(P_{id} * Q_i)}{(P_{ib} * Q_i)}$	$NPCO = \frac{A}{E} = \frac{518.22}{661.45} = 0.78$	0.78
Nominal Protection Coefficient on Input (NPCI)	$NPCI = \frac{B}{F} = \frac{(P_{jd} * X_j)}{(P_{jb} * X_j)}$	$NPCI = \frac{B}{F} = \frac{79.13}{209.28} = 0.38$	0.38
Effective Protection Rate (EPC)	$EPC = \frac{A-B}{E-F} = \frac{(P_{id} * Q_i) - (P_{jd} * X_j)}{(P_{ib} * Q_i) - (P_{jb} * X_j)}$	$EPC = \frac{A-B}{E-F} = \frac{518.22 - 79.13}{661.45 - 209.28} = \frac{439.09}{452.17} = 0.97$	0.97
Domestic Resource Cost (DRC)	$DRC = \frac{G}{(E-F)} = \frac{(P_{ns} * Q_n)}{\{(P_{ib} * Q_i) - (P_{jb} * Q_j)\}}$	$DRC = \frac{G}{E-F} = \frac{521.68}{661.45 - 209.28} = \frac{521.68}{452.17} = 1.15$	1.15
Private Cost Ratio (PCR)	$PCR = \frac{C}{A-B} = \frac{(P_{nd} * X_n)}{(P_{id} * Q_i) - (P_{jd} * X_j)}$	$PCR = \frac{C}{A-B} = \frac{341.67}{518.22 - 79.13} = \frac{341.67}{439.09} = 0.78$	0.78

Source: Computed from PAM Results (Appendix IV)

Appendix VC: Wa West District Competitiveness and Economic Efficiency Indicators

Indicator	Formulae	Computation	Results
Nominal Coefficient on Output (NPCO)	$NPCO = \frac{A}{E} = \frac{(P_{id} * Q_i)}{(P_{ib} * Q_i)}$	$NPCO = \frac{A}{E} = \frac{487.28}{536.94} = 0.86$	0.86
Nominal Protection Coefficient on Input (NPCI)	$NPCI = \frac{B}{F} = \frac{(P_{jd} * X_j)}{(P_{jb} * X_j)}$	$NPCI = \frac{B}{F} = \frac{51.73}{227.97} = 0.23$	0.23
Effective Protection Rate (EPC)	$EPC = \frac{A-B}{E-F} = \frac{(P_{id} * Q_i) - (P_{jd} * X_j)}{(P_{ib} * Q_i) - (P_{jb} * X_j)}$	$EPC = \frac{A-B}{E-F} = \frac{487.28 - 51.73}{536.94 - 227.97} = \frac{435.55}{335.97} = 1.30$	1.30
Domestic Resource Cost (DRC)	$DRC = \frac{G}{(E-F)} = \frac{(P_{ns} * Q_n)}{\{(P_{ib} * Q_i) - (P_{jb} * Q_j)\}}$	$DRC = \frac{G}{E-F} = \frac{413.7}{563.94 - 227.97} = 1.23$	1.23
Private Cost Ratio (PCR)	$PCR = \frac{C}{A-B} = \frac{(P_{nd} * X_n)}{(P_{id} * Q_i) - (P_{jd} * X_j)}$	$PCR = \frac{C}{A-B} = \frac{451.04}{487.28 - 51.73} = 1.04$	1.04

Source: Computed from PAM Results (Appendix IV)

where:

P_{id}= Domestic Price of 0utput i

P_{ib}= International price of output i

P_{jd}= Domestic price of tradable input j

P_{jb}= International price of tradable input j

P_{nd}= Market price of non-tradable input n

P_{ns}= Shadow price of non-tradable in n

Q_i= Quantity of output i

X_j= Quantity of tradable input j

X_n= Quantity of non-tradable input n

Appendix VD: Nadowli District Competitiveness and Economic Efficiency Indicators

Indicator	Formulae	Computation	Results
Nominal Coefficient on Output (NPCO)	$NPCO = \frac{A}{E} = \frac{(P_{id} * Q_i)}{(P_{ib} * Q_i)}$	$NPCO = \frac{A}{E} = \frac{645.39}{601.39} = 1.07$	1.07
Nominal Protection Coefficient on Input (NPCI)	$NPCI = \frac{B}{F} = \frac{(P_{jd} * X_j)}{(P_{jb} * X_j)}$	$NPCI = \frac{B}{F} = \frac{111.8}{234.13} = 0.48$	0.48
Effective Protection Rate (EPC)	$EPC = \frac{A-B}{E-F} = \frac{(P_{id} * Q_i) - (P_{jd} * X_j)}{(P_{ib} * Q_i) - (P_{jb} * X_j)}$	$EPC = \frac{A-B}{E-F} = \frac{645.39 - 111.8}{601.39 - 234.13} = \frac{533.59}{367.26} = 1.45$	1.45
Domestic Resource Cost (DRC)	$DRC = \frac{G}{(E-F)} = \frac{(P_{ns} * Q_n)}{\{(P_{ib} * Q_i) - (P_{jb} * Q_j)\}}$	$DRC = \frac{G}{E-F} = \frac{521.18}{601.39 - 234.13} = \frac{521.18}{367.26} = 1.42$	1.42
Private Cost Ratio (PCR)	$PCR = \frac{C}{A-B} = \frac{(P_{nd} * X_n)}{(P_{id} * Q_i) - (P_{jd} * X_j)}$	$PCR = \frac{C}{A-B} = \frac{388.45}{645.39-111.8} = \frac{388.45}{533.59} = 0.73$	0.73

Source: Computed from PAM Results (Appendix IV)

Appendix VE: Sissala West District Competitiveness and Economic Efficiency Indicators

Indicator	Formulae	Computation	Results
Nominal Coefficient on Output (NPCO)	$NPCO = \frac{A}{E} = \frac{(P_{id} * Q_i)}{(P_{ib} * Q_i)}$	$NPCO = \frac{A}{E} = \frac{486.49}{642.35} = 0.76$	0.76
Nominal Protection Coefficient on Input (NPCI)	$NPCI = \frac{B}{F} = \frac{(P_{jd} * X_j)}{(P_{jb} * X_j)}$	$NPCI = \frac{B}{F} = \frac{73.45}{210.92} = 0.35$	0.35
Effective Protection Rate (EPC)	$EPC = \frac{A-B}{E-F} = \frac{(P_{id} * Q_i) - (P_{jd} * X_j)}{(P_{ib} * Q_i) - (P_{jb} * X_j)}$	$EPC = \frac{A-B}{E-F} = \frac{486.49-73.45}{642.35-210.92} = \frac{413.04}{431.43} = 0.96$	0.96
Domestic Resource Cost (DRC)	$DRC = \frac{G}{(E-F)} = \frac{(P_{ns} * Q_n)}{\{(P_{ib} * Q_i) - (P_{jb} * Q_j)\}}$	$DRC = \frac{G}{E-F} = \frac{459.76}{642.35} = \frac{459.76}{431.43} = 1.07$	1.07
Private Cost Ratio (PCR)	$PCR = \frac{C}{A-B} = \frac{(P_{nd} * X_n)}{(P_{id} * Q_i) - (P_{jd} * X_j)}$	$PCR = \frac{C}{A-B} = \frac{350.8}{486.49 - 73.45} = \frac{350.8}{431.43} = 0.81$	0.81

Source: Computed from PAM Results (Appendix IV)

Appendix VI: ESTIMATIMATION OF PRIVATE AND SOCIAL CAPITAL

Capital:			
Working capital (A)		94.4	GH¢/Acre
Tractor services (B)		37.82	GH¢/Acre
Thresher (C)		0	
private capital (A+B+C)		**132.22**	
Adjust private capital by BOG prevailing lending rate in year 2011	30%	39.666	
Social Capital (GH¢/acre)		**171.886**	

Source: Calculate from Field Data and Bank of Ghana (BOG) lending rate.

Appendix VII: Estimation of Opportunity Cost of an Acre of Farmland Used To Produce Soybean

District	GH¢/acre
Wa Municipal	
Average Returns from Best alternative crop(maize)(A)	730.96
Less Average Cost /Acre (B)	412.66
Opportunity Cost of land (A-B)	**318.3**
Wa West District	
Average Returns from Best alternative crop(maize)(A)	641.67
Less Average Cost /Acre (B)	541.19
Opportunity Cost of land (A-B)	**100.48**
W East District	
Average Returns from Best alternative crop(maize)(A)	778.38
Less Average Cost /Acre (B)	560.6
Opportunity Cost of land (A-B)	**217.78**
Nadowli District	
Average Returns from Best alternative crop(maize)(A)	755.31
Less Average Cost /Acre (B)	497.34
Opportunity Cost of land (A-B)	**257.97**
Sissala West District	
Average Returns from Best alternative crop(maize)(A)	670.68
Less Average Cost /Acre (B)	416.78
Opportunity Cost of land (A-B)	**253.9**
Upper West Region as a Whole	
Average Returns from Best alternative crop(maize)(A)	725.02
Less Average Cost /Acre (B)	524.89
Opportunity Cost of land (A-B)	**200.13**

Source: Computed from Field Data, 2012

Appendix VIII: Average Production Costs for Soybean in Upper West Region for 2011/2012 Season (Private Prices)

Labour use	Cost(GHS/Acre)
Total Labour cost (C1)	140
Inputs	
Fertilizer	101.8
Seed	13.96
Chemicals	15.52
Total Tradable Input(B)	131.28
Land Rent (C2)	156.43
Capital (C3)	132.22
Production	678.98
Price	0.83
Total Revenue (A)	563.56
Total Cost (C1+C3+B)	559.93
Gross Profit	183.1
Less Land Rent	156.43
Net Profit	3.63

Source: Computed from Field Data, 2012

Appendix IX: Average Production Costs for Soybean Production in Upper West Region for 2011/2012 season (Social Prices)

Domestic Factors	Cost(GH¢/Acre)	
Total Labour cost	**140**	
Opportunity Cost of Land	200.13	
Capital	171.87	
Total Cost of Domestic Factors(G)	**513.71**	
Inputs		
Fertilizer	188.83	
Seed	12.49	
Chemicals	11.79	
Total Tradable Input(F)	**213.11**	
Production	678.98	KG/Acre
C.I.F Price + Transportation and Handling Costs	0.9924	Price/Kg
Total Revenue (E)	**673.82**	
Total Cost (G+F)	**726.82**	
Net Profit (E-G-F)	**-51.31**	

Source: Computed from Field Data and GSS Data, 2012 (see Appendix III)

Appendix: X Import/ World Price of Maize for the Year, 2011

Product	Custom Value(GH¢)	Weight (KG)
Maize seed	5322.87	44800
Maize seed	2396.79	27000
Maize seed	12300.28	1035
Maize seed	4886.78	14850
Maize seed	1461932.78	574810.57
Maize seed	1041.26	230
Maize seed	17757.84	1197
Maize seed	1135.14	44836.36
Maize seed	29035.37	2778.51
TOTAL	**1535809.11**	**711537.44**
Price (GH¢)/KG	**2.158437524**	

Source: Ministry of Trade (MOTI), 2012

Appendix XI: PAM Results for Soybean Production in Upper West Region by Farming Systems.

	Revenue	Cost								Profit
		Tradable Input				Domestic Factors				
		Fertilizer	Seed	Chemicals	Total	Labour	Land	Capital	Total	
Small Scale (farm sizes up to 5acres)										
Private prices	566.85	50.27	13.45	9.42	73.14	148.41	156.43	141.29	446.13	47.58
Social prices	674.27	188.83	13.35	7.07	209.25	148.41	261.21	183.68	593.3	-128.28
Divergences	-107.42	-138.56	0.10	2.35	-136.11	0	-104.78	-42.39	-147.17	175.86
Large Scale (farm sizes greater than 5acres)										
Private prices	532.84	42.12	16.05	20	78.17	106.27	156.43	107.18	369.88	84.79
Social prices	664.4	188.83	15.96	16.92	221.71	106.27	193.31	139.33	438.91	40.71
Divergences	-131.56	-146.71	0.09	3.08	-143.54	0	-36.88	-32.15	-69.03	81.01

Source: Computed from Field Data, 2012 and Ghana Statistical Service Data, 2012

Appendix XII: Estimation of Competitiveness and Efficiency Indicators for Farming Systems

Appendix XIIA: Competitiveness and Economic Efficiency Indicators for Large Scale Farmers

Indicator	Formulae	Computation	Results
Nominal Coefficient on Output (NPCO)	$NPCO = \frac{A}{E} = \frac{(P_{id} * Q_i)}{(P_{ib} * Q_i)}$	$NPCO = \frac{A}{E} = \frac{532.84}{664.4} = 0.80$	0.80
Nominal Protection Coefficient on Input (NPCI)	$NPCI = \frac{B}{F} = \frac{(P_{jd} * X_j)}{(P_{jb} * X_j)}$	$NPCI = \frac{B}{F} = \frac{78.17}{221.71} = 0.35$	0.35
Effective Protection Rate (EPC)	$EPC = \frac{A-B}{E-F} = \frac{(P_{id} * Q_i) - (P_{jd} * X_j)}{(P_{ib} * Q_i) - (P_{jb} * X_j)}$	$EPC = \frac{A-B}{E-F} = \frac{532.84-78.17}{664.40-221.71} = \frac{550.04}{480.71} = 1.03$	1.03
Domestic Resource Cost (DRC)	$DRC = \frac{G}{(E-F)} = \frac{(P_{nd} * Q_n)}{\{(P_{ib} * Q_i) - (P_{jb} * Q_j)\}}$	$DRC = \frac{G}{E-F} = \frac{438.91}{664.40-221.71} = \frac{438.91}{442.69} = 0.99$	0.99
Private Cost Ratio (PCR)	$PCR = \frac{C}{A-B} = \frac{(P_{nd} * X_n)}{(P_{id} * Q_i) - (P_{jd} * X_j)}$	$PCR = \frac{C}{A-B} = \frac{369.88}{532.84-78.17} = \frac{369.88}{454.67} = 0.81$	0.81

Source: Computed from PAM Results (Appendix XI)

Appendix XIIB: Competitiveness and Economic Efficiency Indicators for Small Scale Farmers

Indicator	Formulae	Computation	Results
Nominal Coefficient on Output (NPCO)	$NPCO = \frac{A}{E} = \frac{(P_{id} * Q_i)}{(P_{ib} * Q_i)}$	$NPCO = \frac{A}{E} = \frac{566.85}{674.27} = 0.84$	0.84
Nominal Protection Coefficient on Input (NPCI)	$NPCI = \frac{B}{F} = \frac{(P_{jd} * X_j)}{(P_{jb} * X_j)}$	$NPCI = \frac{B}{F} = \frac{73.14}{209.25} = 0.35$	0.35
Effective Protection Rate (EPC)	$EPC = \frac{A-B}{E-F} = \frac{(P_{id} * Q_i) - (P_{jd} * X_j)}{(P_{ib} * Q_i) - (P_{jb} * X_j)}$	$EPC = \frac{A-B}{E-F} = \frac{566.85-73.14}{674.27-209.25} = \frac{493.71}{465.02} = 1.06$	1.06
Domestic Resource Cost (DRC)	$DRC = \frac{G}{(E-F)} = \frac{(P_{nd} * Q_n)}{\{(P_{ib} * Q_i) - (P_{jb} * Q_j)\}}$	$DRC = \frac{G}{E-F} = \frac{593.30}{674.27-209.25} = \frac{493.71}{465.02} = 1.28$	1.28
Private Cost Ratio (PCR)	$PCR = \frac{C}{A-B} = \frac{(P_{nd} * X_n)}{(P_{id} * Q_i) - (P_{jd} * X_j)}$	$PCR = \frac{C}{A-B} = \frac{446.13}{674.27-209.25} = \frac{446.13}{493.71} = 0.90$	0.90

Source: Computed from PAM Results (Appendix XI)

Appendix XIII: Summary of Research from Problem Statement to Recommendations

Problem Statement	Research Questions	Specific Objectives	Methods of Analysis	Results	Conclusions	Recommendations
Despite years of government policy support in soybean production, little or no study has been conducted to assess the private incentives for farmers to continue its production and the sustainability of its production if the support systems are withdrawn.	Is soybean production in the Upper West Region profitable privately and socially?	To analyze the private and social profitability of soybean production in the UWR.	Policy Analysis Matrix (PAM) top row D=A-(B+C) (Private) Policy Analysis Matrix (PAM) middle row. H=E-(F+G) (Social)	Soybean production is competitive at the farm level, evidenced by a positive private profit of GH₵3.63/acre and a PCR ratio of 0.94 Socially, soybean production in UWR is not profitable. This is demonstrated by a negative social profit and DRC ratio of 1.11.	Positive private profit is expected to motivate farmers to expand the production of the crop, provided land is available and substitute crops are not more privately profitable. Negative social profit indicates that the system uses domestic resources inefficiently and hence lacks comparative advantage. This implies that the soybean industry cannot survive without government support.	Government should continue to provide support systems (subsidies) to ensure the sustainability of the commodity system.
Due to distortions in factors and output markets, externalities and government policy interventions, social or economic profitability may deviate from their private counterparts (Quddus et al., 2011). However, literature is silent about the extent of divergence between private and social profit.	What are the transfer effects of government policy on soybean production in UWR?	To measure the transfer effects of government policy on soybean production in UWR.	PAM's Bottom row L=D-H or L=I-(J+K)	The divergence between private and social profit is positive (GH₵54.94/acre). The Nominal Protection Coefficient on Input (NPCI) for the soybean production is less than 1 (0.62). This result is reinforced by the negative inputs transfer (GH₵ -81.83/acre). A negative factor transfer of GH₵ -85.06/acre caused mainly by capital and land transfers.	This means that overall, government policy provides incentives for farmers to produce soybean. It also implies that the net effect of policy in the input and output markets will result in positive social benefits. This suggests that the policy regime favours farmers and reduces the cost of tradable inputs to some extent-soybean production was slightly subsidized by policy on tradable inputs. The divergence between the private and social prices of land and capital show the inherent poor development of the capital and agricultural land markets in the Upper West Region.	The current policy environment should be maintained-government should continue to provide incentives for soybean production. Government should promulgate policies that will facilitate the development of rural institutions in the financial and land sectors to enable them provide efficient services.
Some inherent constraints affect soybean production	What are the constraints to soybean	To identify and rank the constraints	Kendall's Coefficient of Concordance	Water stress was identified and ranked as the major constraint	To enhance the production of soybean in the U WR, water stress, must be addressed.	The government should provide irrigation facilities to solve the problem of water stress.

and hence the competitiveness of the industry?	production in UWR?	to soybean production in UWR	(W)			