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AGRICULTURAL HOUSEHOLDS AND THE PROTECTION OF THE RICE INDUSTRY IN GHANA

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DEDICATION

I DEDICATE THIS WORK TO MY PARENTS, MR DARIMAANI (DECEASED) AND MRS DARIMAANI, MY SON BRIGHT DARIMAANI, MY BELOVED WIFE, EVELYN NUMBEH AND TO ALL MY SIBLINGS.

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FELIX NGMENKAARA DARIMAANI

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List of Acronyms

AIDS	Almost Ideal Demand Systems
CPP	Convention People Party
ERP	Economic Recovery Programme
EU	European Union
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Statistic
FASDEP	Food and Agriculture Development Policy
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GLSS	Ghana Living Standard Survey
GSS	Ghana Statistical Service
MOFA	Ministry of Food and Agriculture
MOTI & PSI	Ministry of Trade and Industry and Presidential Special Initiatives
MTADP	Medium Term Agricultural Development Programme
NERICA	New Rice for Africa
NLC	National Liberation Council
OECD	Organization for Economic Cooperation
OPY	Operation Feed Yourself
PP	Progress Party
QUAIDS	Quadratic Almost Ideal Demand System
SAP	Structural Adjustment Programme
SRID	Statistics, Research and Information Directorate
USA	United States of America
WARDA	Africa Rice Center
WTO	World Trade Organization

CHAPTER 1

1.1 Introduction

Food security is a major concern to many developing countries. It is an important aspect of human welfare. As a result of food security, the Ministerial Declaration of the WTO Doha Conference, held in November, 2001 agreed that special and differential treatment for the developing countries should be an integral part of the negotiations to effectively take account of their development needs, including food security. Although there are several definitions for food security, MOFA (2002: 16) defines it as "good quality nutritious food, hygienically packaged and attractively presented, available in sufficient quantities all year round and located at appropriate places at affordable prices"[1] This means that, the food must have quality nutritional value, must be sufficient and available at the right time at affordable prices.

The first safety net against food insecurity must be self production leading to self-sufficiency. Therefore, there is the need to protect the local food production industry to be able to achieve food security and also prevent dumping. The welfare losses to consumers is one of the critical issues considered against protectionism in Ghana. The shortfall can be supplemented through importation (commercial importation and food aid). However, importation to supplement has its own constraints as many developing countries are faced with scarce foreign exchange for competing needs. Notwithstanding the foreign exchange scarcity, the last resort is to import food.

One important food item for food security is rice which is second to wheat in terms of importance and the quantities consumed. Sage V Food website (see footnote below) puts the total production at 560 million metric tonnes[2]. Cantrell (2004) indicated that rice is the lifeline of Asia. He indicated that 56% of humanity, including about 70% of the world's 1.3 billion poor people produce and consume around 92% of the world's rice.

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[1] Food and Agriculture Sector Development Policy (FASDEP), of Ministry of Food and Agriculture (Ghana)
[2] Obtained from Sage V Food website (www.sagefoods.com/mainpages/rice101/production.htm)

Many countries especially in Asia and Africa have the weather conducive for the cultivation of this crop. However, these countries are unable to attain self-sufficiency as a result of international competition. Ghana is of no exception to this situation. Ghana has a lot of wet valleys which are often suitable for rice production. However, she has not been able to achieve self-sufficiency in rice production. This research paper is to look into the case of Ghana

1.2 Background and problem statement

Rice is an important food diet in the world. It runs second to wheat in its importance as a food cereal in human diet. Ghana's production as at 2005 stands at 242,000 metric tonnes[3] which is less than 0.05% of the world production. The rice producing area totals 45% of the total area planted to cereals (Kranjac-Berisavljevic, 2000). The rice sector is an important provider of rural employment and livelihood. Rice is consumed by almost every household. Per capita consumption of rice has doubled 7 kg/year[4] in 1989 to about 14.5 kg/year[5] in 2005. This growing trend in consumption could be attributed to increasing population, rapid urbanization, relative ease of preservation and cooking and development of rice trade as a result of trade liberalization.

Considering the importance of rice in the country in its contribution to GDP, creation of rural employment and also as a food security crop, attempts have been made by governments to develop the rice sector such that Ghana can be self-sufficient. Available literature indicates that, rice had been a protected crop since independence in 1957, when it was targeted for import substitution under the government's food self-sufficiency drive (Asuming-Brempong 1987; Jebuni et al 1990). During the 1960, government operated an import quota system that restricted rice imports and heavily subsidized rice inputs. This probably increased the self sufficiency of Ghana from it low figure of 28.8 between 1960 and 1964 to 48.3 between 1970 and 1974.

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[3] Obtained from FAO statistics website (www.faosatat.fao.org/faostat/servlet) The figure is paddy

[4] Francis Ofori, (2001) current levels of rice production in Ghana

[5] SRID, Facts and figures, 2005

With the introduction of the Economics Recovery Programme (ERP) and the SAP in the 1980s, government adopted a trade liberalization policy. In support of that, the government abolished input subsidies and minimum price support for farmers and liberalized the importation and distribution of rice and also the exchange rate. Local rice had to compete with the imported rice under trade liberalization. The withdrawal of the input subsidies led to decline in profitability resulting in the decline in production. Moreover, the dumping of subsidized imported rice from the USA, Thailand and other European countries further damping the prices of rice thus leaving farmers out of production. Self-sufficiency reduced from the 48.3% between 1970 and 1974 to 41.3% in the 1980s. This further reduced to 15.1 % between 1989 and 1996.

Table 1 Rice Sufficiency

Period	1960-64[a]	1970-74[a]	1980-84[a]	1989-96[b]
Rice Self-sufficiency (%)	28.8	48.3	41.2	15.1

Source: [a]. Nyanteng, 1998 and [b]. FAO trade, 1998

The liberalization policy of government was sort to eliminate bottlenecks regarding inefficient use of resources in the sector and also to attract private investors to boost the local production. Though there have been increases in the local production, these increases have been very marginal and moreover, the self-sufficiency dream of successive governments have not been fruitful.

From table 2 below, it can be seen that production over the period even though has been increasing is marginal and it is unable to meet the domestic demand. Imports have always been higher than the domestic production even though Ghana has all it takes to increase the production. Major importing countries according to Antwi-Asare, 2005 are USA, Thailand, Vietnam, China, India, EU and Japan even though rice is imported from as many as 44 countries (ibid). Analysis carried out by Assuming-Brempong using data from Ministry of Trade and Industry indicated that, USA and Thailand lead (33%) in the imports of rice. This is followed by Vietnam (19%), China (10%) and India (5%).

Table 2 Trend of Rice Production and Imports (mt)

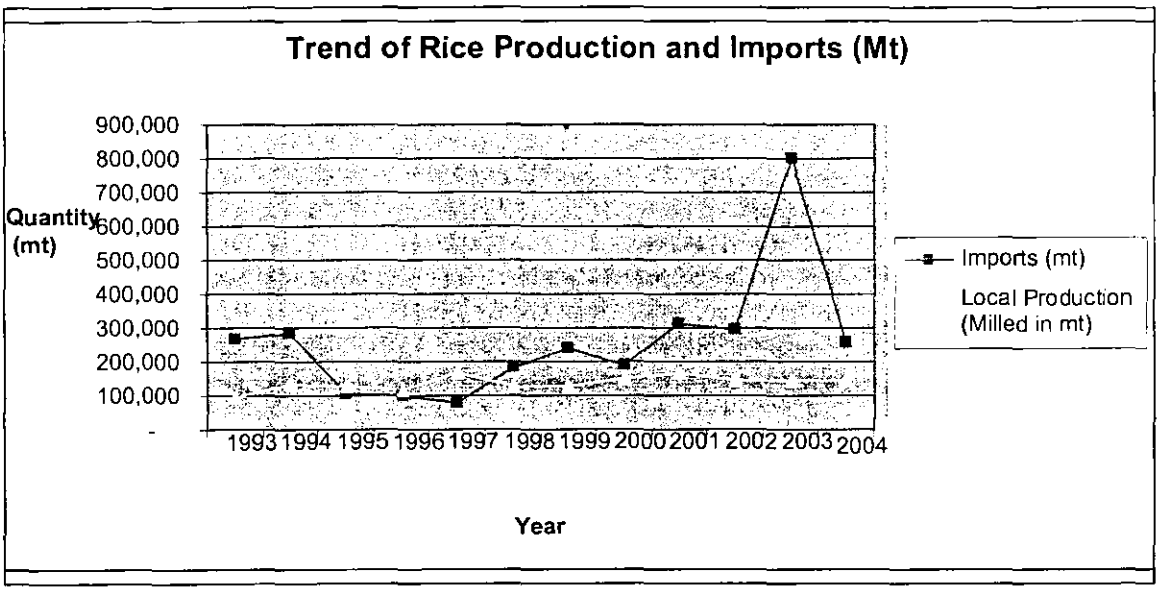
Year	Domestic Production	Milled[6]	Imports
1993	162,000	97,000	268,937
1994	162,000	97,000	281,112
1995	221,000	133,000	104,267
1996	216,000	130,000	99,775
1997	197,000	118,000	76,074
1998	280,000	169,000	182,830
1999	210,000	126,000	241,610
2000	215,000	129,000	187,256
2001	253,000	152,000	311,513
2002	280,000	168,000	296,953
2003	239,000	143,000	797,705
2004	242,000	145,000	253,905

Source: SRID, Facts and Figures, 2005

[6] 60% of Paddy

Figure 1 below shows the trend of domestic rice production as compared to the imports. It shows that, the imports are increasing whilst the domestic production is stagnating between 100,000 and 150,000 metric tonnes.

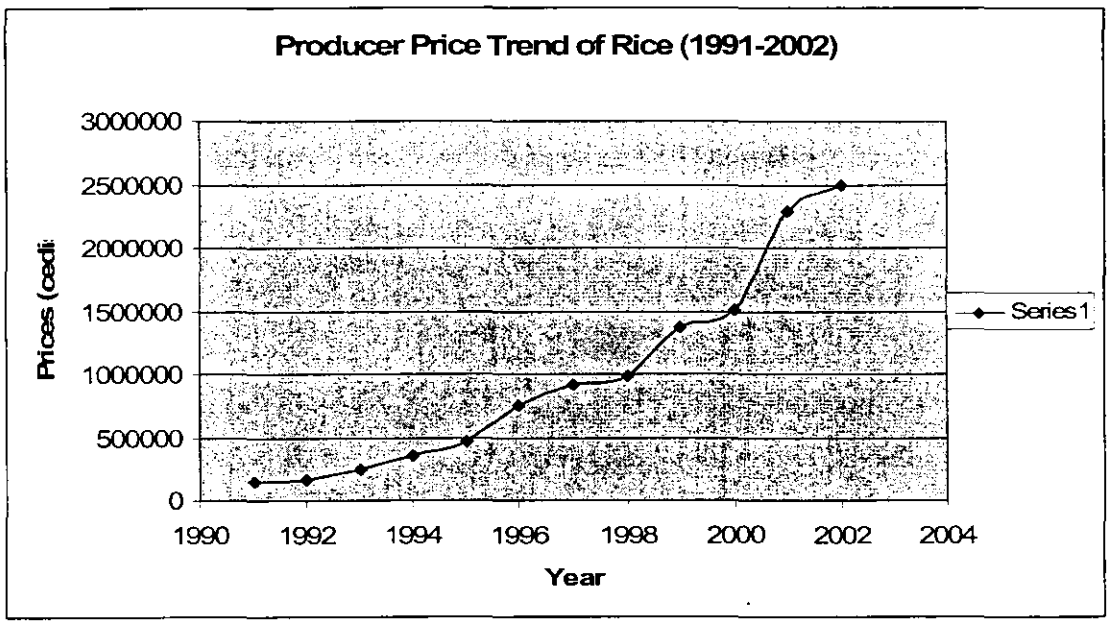
Figure 1: Trend of Rice Production and Imports



Source: Drawn by writer using data from SRID, Facts and Figures, 2005

The graph below also shows the price trend of rice in Ghana. Despite the increases in prices over the period, these prices are still below the prices that can enable farmers make profit and even in some cases breakeven. Rice farming in Ghana basically is done by small scale farmers and so they are unable to benefit from economies of scale.

Figure 2 Producer Price Trend of Rice (1991-2002)



Source: Drawn by writer using figures from FAOSTAT, 2006

There have been concerns on how to develop the rice sector in Ghana considering its importance to the country. Economic theory indicates that, when the price of a commodity increases, the producer responds positively by increasing production. With this theory in mind, many stakeholders, especially the rice producers association, millers and middlemen in the rice industry advocate for the use of trade policy instruments for the protection as a means of import substitution. Increases in tariffs lead to increases in prices and thereby serving as incentive for increases in production. This argument is advanced because WTO permits Ghana to raise tariffs on rice imports to 99% from 2005 onwards (Antwi-Asare, 2005). Government in 2003 in its budget statement announced an increase in the imported rice tariff from 20% to 25% with the objective of promoting domestic production and also conserving foreign currency. In spite of public and media support for the bold action taken by government, the increment had to be withdrawn due to pressure from the IMF.

The issues that are raised from debates on the development of the rice industry have been to protect the rice industry through increases in import tariffs. However, the effect of the tariff

increases on the general welfare of citizen's especially agricultural household is often not analyzed. Considering the fact that Ghana is mainly an agricultural country with over 55% of it populace engaged in agriculture, and the fact that, agricultural households are producers and consumers as well, the increase in tariff will have different effect on them. The issues that arise then are; what is the effect of increases on tariffs on the demand and supply of rice? What are the responses of farmers and consumers to tariff increases?

1.3 Relevance of the study

Rice consumption pattern has increased over the years due to increasing population and urbanization. Per capita consumption has doubled within the last 15 years. Unfortunately, local production is unable to support the high demand thus making Ghana a net importer of rice. Self-sufficiency ratio fluctuates between 50 and 15 despite the fact that, the country is blessed with wetlands which are conducive for rice production. Practically, rice is produced in all the 10 administrative regions of the country. Rice has become a very strategic food crop for Ghana, either in terms of global economy (trade balance), poverty reduction for both producers and consumers and also for food security.

Considering the crop as a major staple and the increased consumption pattern, the Ministry of Food and Agriculture in its main policy document, (FASDEP 2002) included rice as one of the selected commodities for development. The policy was to ensure food security and promote import substitution. The thrust was to reduce the importation of rice by 30% by 2004 by increasing production level to about 370,000 mt. The Ministry however could not achieve its production target as production levels as at 2004 was just 145,000 mt and imports still very high (see table 2).

The favourable conditions such as wetlands and good climatic conditions, the consumption pattern, its importance in the global economy (trade balance), culminated with the food security role it plays requires attention and focus on the crop. The favourable conditions are unable to be tapped due to the dumping of rice in the form of imports or as food aid which in comparison to domestically produced rice is cheaper.

Though there have been adequate literature on the production techniques, there seem to be limited literature on the economics of rice production in Ghana especially in the analysis of the effect of tariffs on agricultural household. To the best of my knowledge, this is the first study investigating the effect of increased rice prices on agricultural households. It is hoped that this study will add to the scanty literature on the economics of rice production and will also provide some basis for the government in its future rice policies.

1.4 Research Objectives and Research Questions

The main objective of the paper is to investigate the effect of tariff increases on the welfare of agricultural households and to provide policy advice to government. The specific object of the study is to address the following research questions; what are the effects of tariff increases and hence price increases? (a) What is the price elasticity of demand of rice? (b) What is the price elasticity of supply of rice?

There have been arguments that, the imported rice have had negative effect on the development of the local rice industry and that, increases in tariffs will reduce the quantity of rice imported but increase domestic production. This study will confirm the responsiveness of the farmers and consumers to increases in prices of rice as a result of increases in tariffs

1.5 Methodology

Data of the Ghana Living Standard Survey (GLSS) is obtained from the Ghana Statistical Services for the analysis. The GLSS is a detailed 12-months household survey conducted by the Ghana Statistical Service. It involves about 6,000 households covering 300 enumeration areas across the entire country. It contains data on demographic characteristics, health and fertility behavior, education and skill/training, employment and time use, migration, housing and housing conditions and household incomes, consumption and expenditures. It serves as a database for the monitoring, evaluation and analysis of poverty in its various ramifications.

A household agricultural model (see Chapter 4) is used from which the demand and supply functions are derived. The elasticities of demand and supply are then estimated using an OLS

regression. A simulation is further carried out on responsiveness of demand and supply on increases in prices as a result of increases in tariff of rice.

1.6 Organization and scope of paper

The rest of the research paper is organized as follows. Chapter 2 presents the analytical framework of the paper. It uses import substitution and the infant industry arguments. Chapter 3 gives an insight about the rice industry in Ghana. It analyzes the policies implemented by various governments to develop the industry, and also presents the issues at stake affecting the industry. Chapter 4 looks at the theoretical and empirical analysis of the model of agricultural households. Chapter 5 describes the findings of the research whilst chapter 6 concludes with a summary and conclusions.

CHAPTER 2

2.1 Introduction: Analytical Framework

Import substitution has been an old trade strategy that was developed by Friedrich List and was applied in 1879 in Germany to develop infant industry to catch up with Britain in industrial power (Hayami and Godo, 2005). In deed Ha-Joon Chang (2003) calls List the father of infant industry. Import substitution was later adopted widely in most developing countries in the post World War II era to develop their industries and other sectors or sub-sectors. This was because many developing countries were so dependent on the developed countries for almost all consumables especially manufactures. Hayami and Godo (2005) attributed the wide adoption as a form of repulsion against the colonial system which imposed the role of material supply base as well as the manufactured product market on them. Besides, the world depression resulted in the collapse of primary commodity market. So the idea was to look inwardly to be able to produce their goods to reduce the dependency

2.2 Analytical Framework of Tariffs, infant Industries and theory of Protection

Import substitution can be interpreted as identifying policies that are directed towards the reduction of imports and their substitution by domestic production (Södersten and Reed, 1994). The theoretical argument for import substitution is the infant industry argument which in itself, emerges from the theory of external economies of scale.

The import substitution strategy according to its advocates, refer to dual object of greater domestic industrial diversification ("balanced growth") and the ultimate ability to export previously protected goods as economies of scale, low labour costs, and learning by doing which cause domestic prices to become more competitive with world prices (Todaro, 1994). Considering the infant industry argument, at the early stages of development, it is essential to protect some strategic sectors until they reach maturity or big size enough to compete with other sectors in developed countries. This is because, at the early stage, the start-up cost is high and it takes some time for it to be able to increase production in order to lower the unit cost of production to be able to compete effectively with others already established firms.

This allows the firms to realize their true comparative advantage. It was for this argument and many others as mentioned above that, many developing countries after World War II adopted the import substitution. Of course of late, the argument does not only apply to infant industries but now for the prevention of dumping in many countries. For example, President George W. Bush applied protectionism on the steel industry in the Midwest of the US to prevent dumping of cheap steel from other countries[7].

The main instruments used for import substitution are trade policy instruments such as tariffs (Taxes on imports) and non-tariff restrictions (quotas and/or voluntary export restrictions). Brazil, Chile and Argentina used high tariff walls to protect their industries and to industrialize (Maunder et al, 1997). The forms and extent of application of these instruments differ from country to country. Brazil for example used the "law of similar" which made it impossible for firms who import similar goods that could be made locally from accessing government credit, getting tax privileges and also right to bid government's contracts[8]. In India, firms required license to be able to import goods. To obtain an import license, a firm needed to prove beyond every reasonable doubt that, no other domestic firm could meet the required specification that it required[9]. Turkey also used import license as a barrier[10]. They maintained a list of goods for which import licenses were required. Once domestic production of the same item starts, then that particular item is removed from the list. In deed all items that competed with domestic goods were effectively banned.

Ghana just like many developing countries also implemented the import substitution. It used a combination of trade policies to protect their industries. They employed the use of tariffs as well as import quotas and licenses.

The tariffs, infant industries and the theory of protection can be illustrated diagrammatically as shown by Todaro (1995, page 492-494). Consider *figure 3a* which depicts the demand and supply of rice in a small and closed economy (no international trade). The equilibrium home

[7] Visit (http://www.bized.co.uk/current/mind/2003_4/031103.htm) The news: Mind your business-international trade, protectionism and the effects of intervention in markets
[8] 2003 South-Western/Thomson Learning: Chapter 11, Development, Transition and Trade
[9] Ibid
[10] ibid

price is P_1 with a quantity of Q_1. When the country now opens up to world trade, and considering the small size of the economy (which means it can not influence world trade), it faces a horizontal perfectly elastic demand curve with price, P_2. This means that, the commodity (rice) could be sold or bought at the lower world price. From this, it is obvious that, domestic consumers would benefit from the lower price of imports and the resulting greater quantity purchased, whilst domestic producers and their employees would undoubtedly suffer as they lose business to lower-cost foreign suppliers. At this world lower price of P_2, the quantity demanded rises from Q_1 to Q_3 whereas the quantity supplied by domestic producers fall from Q_1 to Q_2. The difference between the quantity demanded by consumers (Q3) and the quantity domestic producers are willing to supply (Q_2) at the lower world price of P_2 is the quantity that is imported and is shown by *bc* in the diagram.

Faced with the potential loss of domestic production and jobs as a result of free trade and desiring to obtain infant industry protection, domestic producers will seek tariff relief from government (ibid). The effect of tariff (equal to t_o) are shown in *figure 3b*. The tariff causes the domestic price of rice to rise from P_2 to P_t i.e. $P_t = P_2 (1+t_o)$. Domestic consumers have to pay the higher price and will reduce their quantity demanded from Q_3 to Q_5. Domestic producers can expand production (and employment) up to quantity Q_4 from Q_2. As a result of the tariff, government makes revenue which is represented by the rectangular *efgh* on the imports.

The higher the tariff, the closer will be the sum of the world price plus the import tax to the domestic price. In the classic infant industry import substitution scenario, the tariff may be so high that it raises the price of the imported produce above P_1 to say P_3 in *figure 3a*, so that imports are effectively prohibited and the local industry is allowed to operate behind a fully protective tariff wall, once again selling Q_1 output at P_1 price.

2.3 Welfare Effects of Import Substitution

It is unambiguous that in the short-run, the impact of such prohibitive tariff affects the consumers who are in effect subsidizing domestic producers and their employees through higher prices and lower consumption. Baffes and Meerman (1998) indicated that, the

protection of a particular sector by the use of tariffs, taxes, price supports etc is a question of equity in the sense that, the marginal welfare of the proposed benefiting group (producers) is in some sense valued more than the proposed loosing group (the consumer or tax payer). However, considering the fact that, in many developing countries the actors in the agricultural sector are both producers and consumers, the policy of prices increases as a result of import tariff increases affect them in different ways. As consumers, it adversely affects them but as producers, it increases their profit from production. In the long-run, proponents of import substitution for the infant industry argue that everybody will benefit as domestic producers reap the benefits of economies of scale and learning by doing so that eventually the domestic price falls below P_2 (the world price). Production will then occur for both the domestic and the world market, domestic consumers as well as domestic producers and their employees will benefit, protective tariffs can then be removed, and the government will be able to replace any lost tariff revenue with taxes on the very much higher incomes of domestic producers.

According to Taylor and Adelman, (2002) some empirically studies conducted using agricultural household models demonstrate that, as expected, increases in the price of a crop increases production of that crop (the own-price elasticity is positive). Therefore in increases the import tariffs, the prices of domestic commodities shoot up thereby serving us an incentive to increase production.

Figure 3a **Tariffs, infant Industries and theory of Protection**

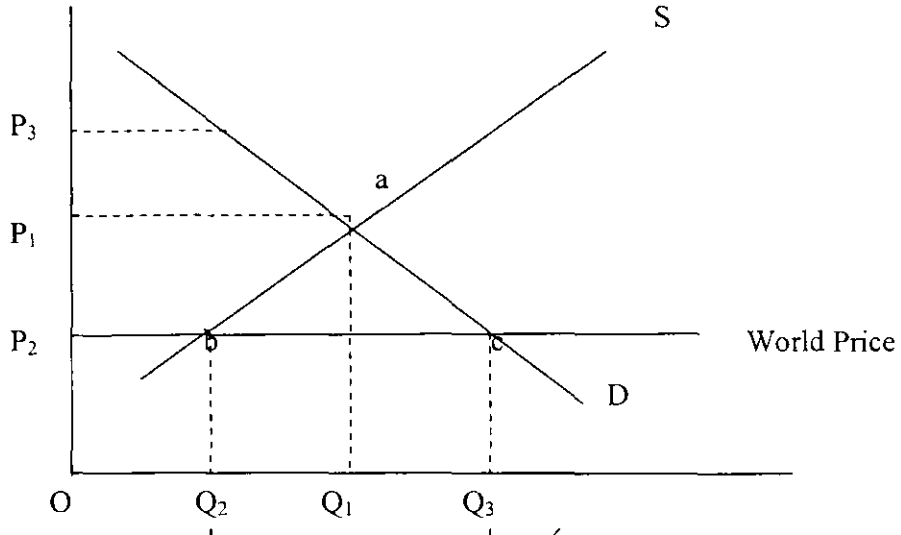
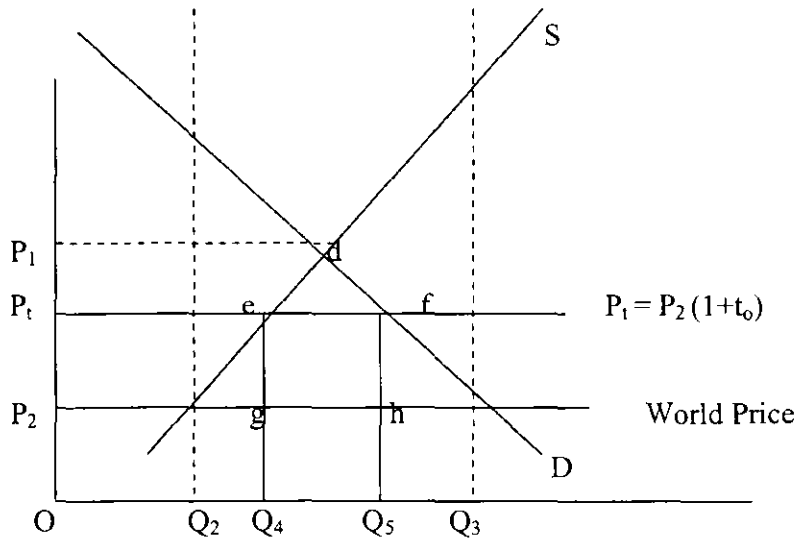


Figure 3 b



Source: Todaro (1995, page 492-494).

2.4 General Empirical Review of Import Substitution

Originally the import substitution strategy was developed for the development of the industrial sectors of least developing countries and so much of the literature is centered on its performance of the industrial sector in relation to the whole economy. There have been a number of extensive research conducted on the import substitution strategy, notable amongst them are those conducted by Bruton (1998) Madison (1970: 1995), Little, Scitovsky and Scott (1970), Bela Balassa and Associates (1971), Riddel (1990) and many others.

The period of import substitution is often divided into 2 stages; the soft stage and the difficult stage. The soft stage spans from 1950 to 1970 and the difficult stage after 1970. Literature indicates that, there was substantial evidence in its success during the soft stage despite a number of problems. Bruton (1998) listed some of the problems as central planning efforts of greatly varying efficacy, set of nominal tariffs and Effective Rates of Protection (ERP) which showed little economic rationale, quotas, exchange controls and overvalued exchange rates that contributed to unemployment and underutilization of capital in the capital-scarce economies.

Despite these distorting problems, there were developments in the two decades (after 1950) that import substitution was vigorously implemented. Brutton in his analysis using data from Madison (1970; 1995) concluded that, the two decades (1950-1970) of implementation was a success. He compared the data before and after 1950 and realized that, the rate of growth of GDP were markedly higher after 1950 except Argentina and Malaya. Investment rates were higher and even agriculture generally penalized in one way or other grew faster in all countries except Argentina and Columbia. Manufactured exports from developing countries increased from a base year of 100 in 1953 to 283 in 1965 (Little, Scitovsky and Scott (1970, p.245). Life expectancy at birth rose in most countries, infant mortality had fallen, literacy rates rose and infrastructure developed and improved Brutton, 1998).

2.5 Critique of the Import Substitution and Alternative Strategy

Notwithstanding the advantages of the import substitution strategy of self-reliance, its ability to attract FDI (Puga et al 1997), create employment, increase government revenue through tariffs (Brecher and Harvey, 2002), its ability to build a strong economy (Besecker, 2003)

etc, critiques have indicated its deficiencies in-terms of misallocation of resources, technical inefficiency and savings gap (Meier, 1976). Todaro (1994) also indicated that, largely, the import substitution strategy has been unsuccessful. Literature on import substitution showed that, it promotes inefficient production (Meier 1976, Todaro 1994, Krugman and Obstfeld, 2000, Besecker, 2003). This is explained by the fact that countries are not using their natural comparative (Krugman and Obstefeld, 2000) and therefore resources that could have been used for the development of other sectors are directed to protecting some sectors. Oxfam (2003) argues in the contrary because, countries in Europe that claim to be efficient are really being supported by hidden subsidies. A case of production in the agriculture sector was cited as being over subsidized. Oxfam used the rice and poultry industry to support their case where farmers in Europe and the USA are subsidized and as a result, they are able to produce at lower cost and export to developing countries to cripple similar industry.

It is further argued by Besecker (2003) that import substitution does not encourage efficient future production. He indicated that, higher tariffs promote little competition and therefore serves as a disincentive for innovativeness. However, Puga et al (1997) argued on the contrary. He argued that, high import tariffs could attract FDI into the importing country to compete with domestic firms. He indicated that as the cost of importation increases, the exporting firm could be attracted to relocating into the importing country to produce in order to reduce the cost.

The size of domestic demand for such import substituted goods according to Meier (1976) often flaws the economics of scale argument especially when a lot of such industries are established. This is because many developing countries are small in size and such protected industries are unable to operate to full capacities to be able to benefit from economies of scale. Cardoso and Helwege, 1992:96 [as cited in Hayami and Godo (2005)], Meier (1976) made an emphasis by citing the case of Latin America automobile industry where a total of 600,000 automobiles were produced by as many as 90 assemblers with a production of only 6,700 cars per firm-far smaller than the minimum efficient plant scale of 50,000 for passenger cars and 20,000 for trucks.

Krueger (1980), Bhagwati, (1983), Livas Elizondo and Krugman, (1992) and the World Bank (2000) made their analysis on rent seeking accruing from protectionism. Krueger (1980) found that, under import substitution, import quotas generated quota rents that amounted to large percentage of GDP.

Todaro (1994) in reviewing the short comings of the import substitution strategy outline the measure of the degree of protection. The nominal rates and the effective rates are used for the measurement of the degree of protection. Todaro defines the nominal rate as the extent in percentages, to which the domestic price of imported goods exceeds what their price would be in the absence of protection. He contrasted it with effective rates which is the difference between the value added in domestic prices and value added in the world prices expressed in percentage. A positive effective rate will always call for protection and he indicated that, most developing countries have a positive effective rate (see Todaro 1994, page 498). The issue of the calculations of the effective rate protection is beyond the scope of this research.

Many critiques of the import substitution strategy often advocates for export promotion of both manufactures and primary commodities. But considering the experience of the developed world already, it will virtually be impossible for the developing world to compete with them. Also the export of primary goods has its own repercussions as the prices of these primary goods are inelastic. The best strategy is then to combine the 2 strategies to develop the infant industries first and to promote the exports.

2.6 Agricultural Protection

Literature indicates that, the protection of agriculture is not uncommon in the world and particularly developing countries (Baffes and Meerman, 1998). In deed, a study conducted by Valdes (1996) of eight Latin American countries found that Chile, Colombia and Dominican Republic protect agriculture, whilst Ecuador, Paraguay and Uruguay protect certain sectors. Coming back home to Africa, many if not all of African countries protected agriculture in one way or the other after independence. Ghana for example protected its agriculture since the 1960s by providing subsidies to farmers as well as setting guarantee prices for farm produce. According to Baffes and Meerman (1998), Nigeria between the periods of 1989 and

1992 maintained official prices on wheat and coarse grains at an average of 82% and 92% respectively above their world market prices. The purpose was to create the incentive for domestic production. Algeria, Morocco and Tunisia protected the same commodities at a combined average of 34% and 13%. Morocco's effective tariff equivalents for wheat and coarse grains were 55% and 69% of the world prices between 1989 and 1993 (Ingco, 1995). Knudsen and others (1990) also reported that in the early and mid-1980s fertilizer subsidies in Sri Lanka and Turkey cost about 1% of total GDP, whilst those in Cote d'Ivoire, Egypt, Gambia and Tunisia ranged between 50-100% of the market price of fertilizer.

The first world is not left out of protection of agriculture. In deed, whilst the developing countries are gradually or have moved away from the protection of agriculture, the developed world is still practicing it. For example Ghana which had protected its agriculture and other sectors of the economy by the use of high tariffs has reduced tariffs levels to about 20% in the name of liberalization. Aart de Zeeuw[11] (see FAO Website: http://www.fao.org/DOCREP/W7440E/w7440e07.htm) mentioned countries such as Switzerland, Norway, Finland, Italy, some parts of Great Britain as implementing protectionist policies to enable their farmers survive. Since the formation of the European Commission, agricultural policies have always been discussed on the basis that, the European countries are not being able to compete in the world market and therefore the need to protect and develop the agricultural sector. The survival of the farmer, unsafe agricultural products and food security are the main reasons for protection in Europe and elsewhere. Many agricultural producers according to de Zeeuw believe that having to compete with producers that have more favourable structures or cost levels is unfair. These arguments advanced by de Zeeuw are similar arguments that, Ghana advances for the protection of its rice sector which is considered as a major food security basket for the nation.

Baffes and Meerman (1998) outlined the differences between the protection and developing countries and OECD countries. They indicated that, whilst the developing countries protect by using import restriction including tariffs, import prohibitions or restrictive import

[11] Aart de Zeeuw's article of 'International Trade in Food and Agricultural Products' was a contribution to "Searching for common ground. European Union enlargement and Agricultural Policy' by Hathaway and Hathaway (eds), 1967 published on (http://www.fao.org/DOCREP/W7440E/w7440e07.htm)

licensing, the OECD countries protect by pegging crop prices above the world market levels and also by using technical restrictive measures. In comparing the cost involved in the two forms, it was indicated that, the one used by the developing countries did not require large budget outlays whilst that practiced by the OECD is much more expensive as it requires substantial fiscal outlays to finance the subsidies needed to encourage exports of the crop surpluses induced by the high prices. For example, the European Union allocated over 1% of its GDP (58 billon euros) in the 1990 to agriculture. The impact of such production and export subsidies therefore lead to untold hardships on developing countries' agriculture as many farmers are denied of their livelihood as a result of cheap agricultural produce.

CHAPTER 3

3.1 Agriculture and the Rice Sector in Ghana

3.2 Agriculture in Ghana

Ghana is mainly an agricultural country with about 51% of the country's labour force engaged in agriculture (GSS, 2000). The country has a land area of about 23.9 million square kilometers and about 57% of which is agricultural land. Only 30% of the agricultural land is under cultivation as at 2005 (SRID, 2005). This means that there is over 20% still available for agricultural production.

Ghana's agriculture has played a very important role in the country's development contributing about 55% to Gross Domestic Product (GDP) in the early 1980s but has declined[12] to about 37% in 2005. Aside its contribution to GDP and employment, it also contributes immensely to foreign exchange earnings and governments revenue. Until 1994, the agricultural sector used to be the highest contributor to government's foreign exchange earnings but it loss this to the mining sector where gold now dominates (Seini 2003). It is also the main source of food for the non-agricultural population (mainly urban population). It also supplies the bulk of the raw materials needed for processing by the agro based industries in the country.

The agricultural sector is made up of five sub-sectors namely; crops (other than cocoa), cocoa, livestock, fisheries and the forestry sub-sectors (see below a table indicating the various sub sectors' contribution to the agricultural GDP).

[12] This decline is attributed to the increasing influence of the services sector in the economy which is now the leading contributor since 1992 (Seini, 2003). Similarly, agricultural employment has declined from over 70% in the 1980s to about 51% in 2000 (ibid). The above trend is consistent with economic development everywhere in the world where agriculture's contribution to GDP and its proportion of employment declines as the economy develops. For example, Ingham[12] (1995) using World Bank figures indicated the same declining trend of employment and GDP in the agricultural sector in low-income, lower-middle-income and upper-middle-income countries. As economic development proceeds, the agricultural sector plays an important role of supplying the labour force needed by the other emerging sectors such as industry (Thirlwall 2006).

Table 3 Contribution of various Sub-sectors to Agricultural GDP.

Sub Sector	Contribution to Agric. GDP
1. Crops (Total)	64
- Roots and Tubers	46
- Plantain	9
- Cereals (maize, rice etc)	7
- Others	2
2. Cocoa	13
3. Forestry	11
4. Livestock/Poultry	7
5. Fisheries	5

Source: MTADP, 1991 as adopted from SRID Facts and Figures

The crop sub sector consist of cereals (including maize, rice, sorghum and millet); roots and tubers (including cassava, yams and cocoyam); industrial crops (such as tobacco, cotton, kola nuts, oil palm, rubber, groundnuts, copra and sugar cane); horticultural crops (such as pineapples, mangos, chilli peppers, ginger, lime and oranges) and other crops such as plantain, banana, beans tomatoes etc. Generally, production in the crop sub-sector is mainly done by smallholder farmers except in the case of some industrial crops, horticultural crops and to a lesser extent the cereals. Dapaah (1995) indicated that only about 15% of the 1.9 million farmers in 1994 had farm holdings greater than 2 hectares. This further reduced as was shown by the facts and figures of SRID (2005) that, about 90% of farm holdings are below 2 ha. This meant that only about 10% have holdings equal to or greater than 2 ha. Even though there are some mechanized farming, the main system of farming is traditional where hoes and cutlasses are the main farm tools.

The importance of the crop sub sector can not be over emphasized. This is confirmed by its contribution (64%) to the agricultural GDP (see table 3 above) and also the role it plays in food security in the country. Even though roots and tubers, and plantain contribute highest in terms of agricultural GDP than cereals, the cereals are rated first in terms of addressing the food security needs of the country. This is because of their storability properties.

3.3 Short History of Rice Cultivation in Ghana

Rice cultivation started in the West as Africa as far as 2000 or 3000 [13]. As at the seventeenth and the eighteenth centuries, rice had become a traditional and a leading commercial crop in Ghana (Asuming-Brempong 1987, Asare, 2000). It became a very important crop in the diet of Ghanaians in the 1880s when large imports were introduced, after it had suffered a set back in the Ghanaian subsistence economy in the 1740s due primarily to the menace of the slave trade and locust invasion of Ghana which destroyed most crops (Asuming-Brempong, 1987).

The main variety grown in Ghana before the arrival of any navigators in West Africa was Oryza glaberima. This variety is an upland variety. However, Oryza sativa was later introduced from Asia after the World war I. All the varieties of the Oryza sativa grown in Ghana are cultivated mainly as lowland rice (swamp rice). A new variety was developed and introduced by the Africa Rice Center (WARDA) in 1999 known as New Rice for Africa (NERICA). It is a hybrid between the Oryza glaberrima and the Oryza sativa and it is known to be an improved variety..

3.4 Production Policies of Government regarding the Promotion of the Rice Sector

3.4.1 Colonial Government

The rice industry has been identified as a very important industry for food security and therefore various regimes of governments have attempted to promote it. The colonial government developed a 10 year plan for the expansion of rice production. In the plan was an extension scheme to assist small-scale rice farmers increase production. A rice mill was established by the colonial administration in Esiama in 1926 to process the paddy.

3.4.2 Governments Policies after Independence

After independence in 1957, various agricultural policies were targeted at general food self-sufficiency and, in particular, self-sufficiency in rice (Kranjac-Berisavjevic et al, 2003). The Nkrumah led government drew up a 7-Year Development Plan for economic and social

[13] Porteres 1976 as quoted by Asuming-Brempong (1987). The exact date as to when rice cultivation started is unknown but it is

development and in the plan were two main pillars namely; industrialization and modern agriculture. Rice was one of the cereals that was earmarked for development[14]. Contrary to the colonial government's support to small scale farmers, the CPP government encouraged large scale farming which led to the plethora of state farms[15] and irrigated rice production sites particularly in Northern Ghana which is known to be well suited for rice production.

Under the National Liberation Council (NLC) and the Busia's Progress Party (PP), rice again featured prominently in their development plans. These governments however discouraged the involvement of the state in production process. The NLC started to liberalize the economy in order to correct the supply bottlenecks and the disequilibrium in the economy that had been created by previous government. These supply bottlenecks were as overvalued exchange rate, balance of payment problems, large external debts, high inflation and falling real incomes. The focus of these governments was small-scale farming.

The Military governments that followed in the 1970s initially targeted small-scale farming through its "Operation Feed Yourself" (OFY) Programme. In deed, Ghana achieved food self sufficiency during the OFY period in 1974 and 1975 in many of the major food crops. Rice, maize and sorghum were the major crops the programme targeted. However, governments support later shifted to the large-scale mechanized farms which used intensive methods, apparently because they hoped that rice production increases could occur faster on large scale farms. This led to the establishment of Ghana Irrigation Authority in the 1970s.

3.4.3 Current Government Policy

The main policy document of the Ministry of Food and Agriculture is the Food and Agriculture Sector Development Policy[16] (FASDEP). The general policy objective is to ensure food security; facilitate the production of raw materials for industry; facilitate

[14] This was evidenced by the production targets that were set for it relative to other crops. Rice production was projected to increase by 188% whilst maize and other cereals were projected to increase by 60% and 24% respectively (see Assuming-Brempong, 1987).

[15] The State Farm Corporations was established in 1962 and heavily supported with farm equipment by government

[16] Food and Agriculture Sector Development Policy, September, 2002

agricultural commodities for export; facilitate effective and efficient input supply and distribution systems; facilitate effective and efficient output processing and marketing system; and formulate and co-ordinate the implementation of policies and programmes for the food and agricultural sector.

Rice has been one of the crops selected[17] by the policy for development. The policy is to ensure food security and promote import substitution. The policy thrust is to reduce imports by 30% by increasing production level to about 370,000 mt. Specific measures to reach this level of production included increased mechanization, increased cultivation of inland valleys and effective and efficient utilization of existing irrigated systems. In addition, varietal improvement and increased seed production and utilization is being pursued. The provision of credit for production, improved processing and marketing will be facilitated.

3.5 Production and Consumption of Rice in Ghana

Production figures from the Ministry of Food and Agriculture indicate that the production has not significantly increased. Production hovers between 162,000 mt and 280,000 (see table 2 above). Domestic rice production has been consistently less than consumption needs. Analysis of the domestic food supply and demand position of major staples by SRID indicated that rice has the highest deficit (199,000 mt) as compared to other crops (see table 4 below).

[17] The selection was based on factors as: availability of technology for the production of the crop; producers' experience with the crop; marketability (export, regional or domestic); comparative advantage; potential for adding value; food security; generation of employment, poverty alleviation and environmental conservation.

Table 4 **Domestic Food Supply and Demand Position (2005)**

Crop	Total Domestic Production	Production Available for Human Consumption[18]	Per Capita Consumption (kg/Annum)	Estimated National Consumption	Deficit/Surplus
Maize	1,171,000	819,000	42.5	918,000	(98,300)
Rice (Milled)	142,000	113,600	14.5	313,000	(199,400)
Millet	185,000	129,500	9.0	194,000	(64,500)
Sorghum	305,000	213,500	14.8	319,000	(105,500)
Cassava	9,567,000	6,697,000	151.4	3,269,000	3,428,000
Yam	3,923,000	3,138,430	42.3	913,000	2,225,400
Plantain	2,792,000	2,373,200	84.0	1,814,000	559,200
Cocoyam	1,686,000	1,349,000	56.0	1,209,000	140,000
Groundnut	420,000	357,000	12.0	258,000	99,000
Cowpea	153,000	130,000	5.0	108,000	22,000

Source: SRID, MOFA (Feb. 2005)
Estimated Population, based on 2000 census figure (18.9 m) and a growth rate of 2.7 % = 21.5m.

Kranjac-Berisavljevic, Blench and Chapman, 2003 in their analysis of the rice industry indicated that, demand for rice has outstripped supply due to population increases, urbanization as well as poor marketing arrangements on the supply side. This table seems to support their assertion considering the deficit. The demand therefore is often met by imports which is over 140% of local production. Rice is imported from as many as 44 countries (ibid) but major importing countries include, USA, Thailand, EU and Japan (Asare 2005).

3.6 Analysis of the causes and effects of rice imports

3.6.1 Trade liberalization

Arguably, a major key factor in the rising imports in Ghana of both agricultural and non-agricultural commodities has been the policy of trade liberalization, with the deregulation of almost all markets for both inputs and outputs.

[18] 70% of Domestic production for maize, millet, sorghum, and cassava. 80% for rice, yam, cocoyam and 85% for plantain, groundnuts and cassava livestock feed, wastage and seed account for the discount

Ghana pursued a trade liberalization policy since the 1980s when it adopted the Structural Adjustment Programme (SAP). Until the adoption of this policy, a number of agricultural products including rice, maize etc had enjoyed government protection through the operation of a price support system and input subsidies and also an import quota system. After liberalizing, the quota system was abolished and the implicit tariff of about 700% (in the 1980s) was reduced to about 20% since 1992 (Assuming-Brempong et al 2006). The removal of the subsidies on fertilizers and agro-chemicals resulted in increases in the cost of production much faster than the price of most agricultural produce, particularly rice, thereby eroding the profitability of these produce and also making them less competitive.

3.6.2 Subsidized production from developed countries

Farmers in developed countries have always enjoyed production subsidies and as such, they have substantial reduction in the cost of production thus reflecting lower prices. Sharma (2005) reported that, between 2000 and 2003, it costs on average $415 to grow and mill one tonne of white rice in the US. However, that rice was exported around the world for just $274 per tonne. Meanwhile the cost of production for a tonne of domestic rice is 2,250,000 cedis ($281) (see attachment....). If the cost of milling is included, it will be higher. From this analysis, it is unambiguously clear that, Ghana comparatively can produce cheaper rice than the USA. Ghanaian rice farmers experience higher cost because of the cost of inputs such as agrochemicals, fertilizers and other machinery and equipment, which are all imported and are expensive. Moreover, the interest rates of credit at the banks are also so high (about 30%) which also add on to the cost.

The exchange rate of the Ghanaian cedi to the US dollar has been depreciating and one expects that the cost of importing should be expensive. But this is not the case due largely to the lower CIF prices which is able to offset the cost of exchange rate.

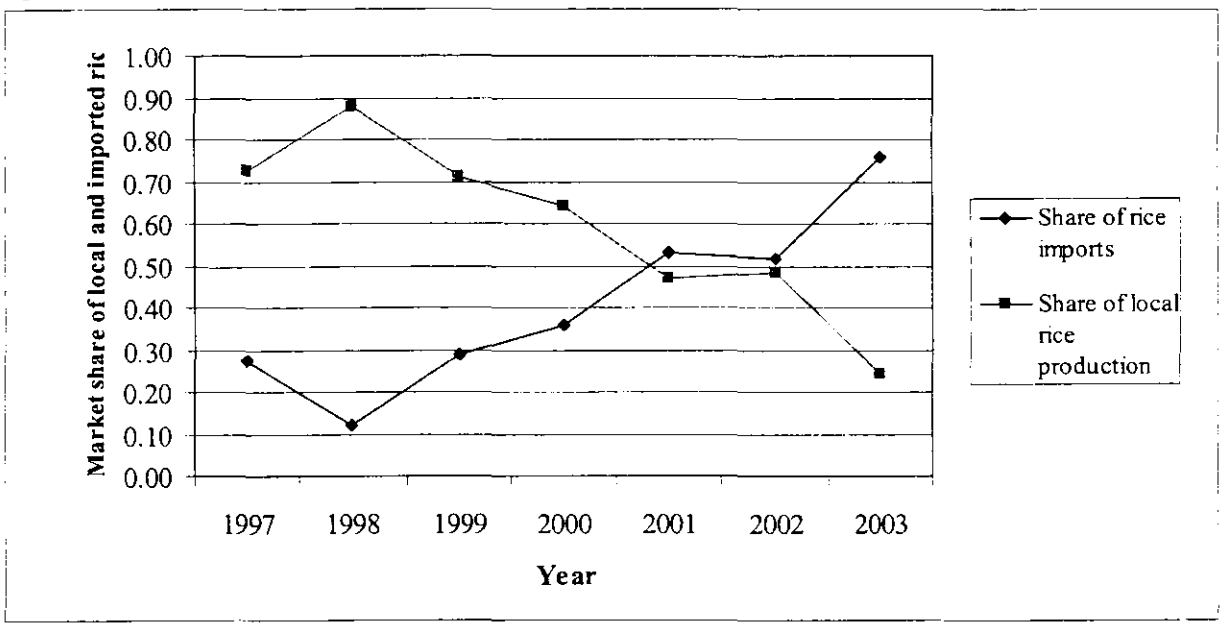
Other factors that cause the increases in importation include the changing preferences of consumers for imported rice and the inability for the producers to meet domestic demand (low production base). It has been established by research (BMOS Agro-Consults LTD, 2004, Antwi-Asare, 2005, Assuming-Brempong, 2006, Ghanaians have developed the taste for imported rice. Reasons attributed for their liking of imported rice is that, the foreign rice

is of good quality. However, it is also reported by Assuming-Brempong that, some local rice is of good quality and are therefore being re-bagged and sold as imported rice. This therefore limits the competition that the quality local rice can pose to the imported rice.

3.6.3 Effect of Imports on Domestic Producers

The main problem that imports of rice has caused is the loss of market share for domestic rice. Assuming-Brempong (2006) using data from the Ministry of Trade, Industry and Presidential Special Initiatives (MoTI & PSI) indicate that, whilst the market share of imported rice is increasing, that for domestic rice is declining. (See figure 4 below)

Figure 4 Market share of local and imported rice in total rice consumption, 1997-2003



Data source: Assuming-Brempong et al (2006) using data from Ministry of Trade and Industry (MOTI), 2005

A loss in the market share of domestic rice has several implications. The stagnation and sometimes the decline in domestic production is loss in producer revenue and therefore profits. It has been estimated that between 2002 and 2003 about 66% of rice producers in Ghana recorded negative returns (Action Aid International (Ghana), 2006). Also many farmers have had to fold up rice farming business because of low returns as a result of cheap imports. This therefore leads to loss of employment and source of livelihood not only for smallholders but also for all stakeholders along the rice supply chain (e.g. traders, millers, transporters etc). For the reason that, farmers are unable to produce, the country has to spend

millions of scarce foreign exchange annually on rice imports, which drains down on the country's foreign reserves and also a major draw back to development efforts.

CHAPTER 4

4.1 Theoretical Understanding of Methodology

The assessment or the analysis of the impact of government policies can be assessed in many ways depending on the focus and the target groups the policy is intended to affect. The main objective of the paper is to investigate the effect of tariff increases on the general welfare of household (especially agricultural households) in Ghana and to provide policy advice to government. The argument has been that, increases of import tariffs will serve as an incentive to farmers to increase production of rice. In this case, this research paper intends to estimate the responsiveness (elasticities) of farmers/suppliers and consumers to increases in price.

A number of methodologies have been used in similar investigations. For example, Wun-chi Lee (1977), Dramane Coulibaly (1979), Sekou Hebie (1984) used a pure consumer model of simple demand and supply for the analysis of the rice industry in Taiwan, Ivory Coast and Burkina Faso respectively. In such an analysis, it is assumed that the consumer's budget is fixed whereas in the agricultural household models it is endogenous and depends on the production decisions that contribute to income through farm profits. For the fact that, the agricultural household is the basis of analysis in this research, this method could not be employed in this research paper.

Almost Ideal Demand Systems (AIDS) models have been found to be used in the analysis of demand for food (Bopape, 2006). However, this method assumes linear Engel curves and constant expenditure elasticities. Such assumptions have been shown to be restrictive, even in developing countries (Meekashi and Ray (1999) and Abdulai (2004) as cited by Bopape (2006). For that matter, Bopape estimated the Quadratic Almost Ideal Demand System (QUAIDS) which relaxes the AIDS assumption. It also controls for expenditure endogeneity and explicitly accounts for the problem of observed zero expenditure. However, this method does not take into consideration the production as well as consumption decisions of households.

Other methods that could be used in the analysis are the general equilibrium (as used by Dyer et al (2001) in which they analyzed in detail staple crops, cash crops and livestock production. Elbers (1992) also used a general equilibrium model to analyze interregional transport in Nepal). Partial equilibrium models which looks at a part of a economy is also used (as used by Ruijs (2002) in his analysis of cereal trade in developing countries), the compensated variation method (as used by Bakhshoodeh and Piroozirad (2003) to determine the effect of price changes on households welfare).

4.2 Agricultural Household Model

The writer employs the agricultural household models in his analysis. Agricultural household models are a staple of micro research on less developed country rural economies and they were originally envisioned as a tool for policy analysis (Taylor Adelman, 2002). Household-farm modeling techniques have been used in a gambit of research ranging from technology adoption and migration to deforestation and biodiversity (ibid). Singh et al 1986 indicated that they provide insight into welfare or real incomes of agricultural household; spillover effects of agricultural policies onto rural non-agricultural economy and at a more aggregate level, the interaction between agricultural policy and international trade or fiscal policy which are of interest to policy makers.

This study intends to estimate the price elasticities of demand and supply of rice and also to simulate the welfare effects of price increases as a result of tariff increases. This model is adopted because; it takes into consideration, the fact that, agricultural households are both consumers and producers of agricultural commodities. Therefore, changes in prices of these commodities affect them as producers and consumers as well. In Ghana over 51% of the working population is engaged in agriculture (GLSS IV 1998/99) and this is a sizeable population that can be affected by pricing policy.

4.3 The Theoretical Model

For any production cycle, the household is assumed to maximize a utility function:

$$U = U(X_a, X_m, X_l) \quad \text{..... 1}$$

Where the commodities are a set of agricultural staples (X_a), a market purchased good (X_m), and leisure (X_l). Utility is maximized subject to a cash income constraint:

$$p_m X_m = p_a(Q - X_a) - w(L - F)$$

Where p_m and p_a are the prices of the market-purchased commodity and staples respectively, Q is the household's production of the staples (so that $Q - X_a$ is its marketed surplus), w is the market wage, L is total labour input, and F is family labour input (so that $L - F$, if positive is hired labour and, if negative, off-farm labour supply).

The household also faces a time constraint – it cannot allocate more time to leisure, on-farm production, or off-farm employment than the total time available to the household:

$$X_l + F = T$$

Where T is the total stock of household time. It also faces a production constraint or production technology that depicts the relation between inputs and output:

$$Q = Q(L, A)$$

Where A is the household's fixed quantity of land?

Important assumption of the model

Singh et al (1986) model ignores variable inputs and also ignores the possibility of producing more than one crop. However, Singh and Janakiram[19] later modified the possibility of producing more than one crop. In their analysis of the agricultural household model of Korea and Nigeria, they used multiple crops environment. This modification brings reality to bare as many rural agricultural households, produces and consumes more than one crop. It also assumes that family labour and hired labour are perfect substitutes in the domestic labour market and conversely, that it can sell its own labour at a given market wage. This permits the household to decouple production from leisure. It is also assumed that production is risk free and that households are price-takers in the three markets and therefore, p_a, p_m and w are not affected by actions of the household.

The three constraints namely; cash income constraint, time constraint and production constraint on the household behavior can be put together into a single constraint (Singh, Squire and Strauss, 1986). Substituting the production constraint into the cash income constraint for Q and substituting the time constraint into the cash income constraint for F, a single constraint is established:

$$p_m X_m + p_a X_a + wX_l = wT + \pi \qquad \text{.....2}$$

Where $\pi = p_a Q(L, A) - wL$ is farm profit. The left hand side of equation 2 indicates total household expenditure on three items - the market-purchased commodity (i.e. $p_m X_m$) , the household's "purchase" of its own output (i.e. $(p_a X_a)$) and the household purchase of its own time in the form of leisure. (i.e. (wX_l)). The right hand-side is Becker's concept of full income in which the value of stock of time (wT) owned by the household is explicitly recorded. The extension for agricultural households includes the measure of farm profits $(p_a Q - wL)$ with all labour valued at the market wage, this being a consequence of the

[19] Singh and Janakiram study of "Agricultural Household Modeling in the a Multicrop Environment: Case Studies in Korea and Nigeria" was used by Singh et al (1986) as a case study in their book entitled "Agricultural Household Models, Extensions, Applications and Policy.

assumption of price-taking behaviour in the labour market (Singh, Squire and Strauss, 1986, Taylor and Adelman, 2002). This assumption implies that, there is a perfect labour market.

The household can choose the levels of consumption for the 3 commodities and the total labour input into agricultural production. The first order condition of each variable can be established. Considering the first order condition of labour, we have:

$$p_a \partial Q / \partial L = w \qquad \text{.....3}$$

The household will equate the marginal revenue product of labour to the marginal wage. This equation contains only one endogenous variable L. The other endogenous variables X_m, X_a and X_l do not appear and therefore do not influence the households choice of L. Accordingly, equation 3 can be solved for L as a function of prices (p_a and w), the technological parameters of the production function, and the fixed area of land. Production decisions can be made independently of consumption and labour-supply (leisure) decisions.

Let the solution for L be:

$$L^* = L^*(w, p_a A) \qquad \text{.....4}$$

This solution can be substituted into the right hand side of the constraint (equation 2) to obtain the value of full income when farm profits have been maximized through an appropriate choice of labour input. Equation 2 could therefore be re-written as

$$p_m X_m + p_a X_a + w X_l = Y^*$$

Where Y^* is the value of full income associated with profit maximizing behaviour. Maximizing utility subject to this new version of constraint yields the following first-order conditions:

$$\left.\begin{aligned} \partial U/\partial X_m &= \lambda p_m \\ \partial U/\partial X_a &= \lambda p_a \\ \partial U/\partial X_l &= \lambda w \\ \text{and} & \\ p_m X_m + p_a X_a + w X_l &= Y^* \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots 5$$

The system of equations in equation 5 are the standard conditions from consumer-demand theory.

The solution to equation 5 yields demand curves of the form

$$X_i = X_i\left(p_m, p_a, w, Y^*\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots 6$$

$$i = m, a, l.$$

That is, demand depends on prices and income. In the case of the agricultural household, however, income is determined by the household's production activities. Taylor and Adelman, 2002, indicated that, the interaction between production and consumption are the trademark of household farm models but these interactions are extremely sensitive to the assumptions about the extent to which households are integrated into product and factor markets. This therefore follows that changes in factors influencing production will change Y^* and hence consumption behaviour. Consumption behaviour, therefore, is not independent of production behaviour.

This model can be used to estimate the effect of changes in certain factors on profit. Assume that the price of the agricultural staple (in this case rice) is increased. What is the effect on consumption of the staple (rice)? From equation 6,

$$\frac{\partial X_a}{\partial p_a} = \frac{\partial X_a}{\partial p_a} + \frac{\partial X_a}{\partial Y^*}\frac{\partial Y^*}{\partial p_a} \qquad \text{.....7}$$

The first term in the right-hand-side is the standard result of consumer-demand theory and for a normal good it is negative. The second term captures the profit effect. A change in price of the staple changes farm profits and hence full income.

$$\frac{\partial Y^*}{\partial p_a} dp_a = \frac{\partial \pi}{\partial p_a} dp_a = Q dp_a$$

The profit effect equals output times the change in price and is there, unequivocally positive.

4.4 Empirical Literature of the Agricultural Household Model

Estimated agricultural household models can be used to analyze a multitude of policy issues relating to agricultural development (Taylor and Adelman, 2002). The early uses of the agricultural household models have all been econometric studies conducted in various geographical regions. They include studies conducted by, Kuroda and Yotopoulos (1978, 1980) in Japan using cross-sectional household data from Japan and grouping them by size and by region, Lau, Yotopoulos and Lin (1976, 1978) in Taiwan, Choon Yong Ahn, Singh and Squire (1981) in Korea; Peter Hazell and Alisa Roell (1983) in Malaysia and Nigeria; Strauss (1984 in Sierra Leone; Kamphol Adulvihaya, Kuroda, Lau and Yotopoulos (1979, 1984) in Thailand. Others include Barnum and Squire (1978, 1979 a, b) in Muda River in Malaysia. All these studies emphasized on price analysis and according to Taylor and Adelman, (2002) showed the expected results that, an increase in the price of a crop serves as an incentive to increase production of that crop (i.e., the own price elasticity is positive) and that they also revealed positive consumption effects through farm profits.

Apart from the price analysis that earlier users of the model had put it into, others have used it for the analysis of off-farm labour supply (Huffman, 1980, 1991 and 2001), technology policy, nutrition policy, and downstream growth of labour supply, migration (Barnum and Squire, 1979), income distribution, savings (Lluch, Powell and Williams, 1977) and family

planning (Strauss 1984 and Barnum and Squire, 1979) (as reported by Taylor and Adelman, 2002). Whilst Huffman in 1980, 1991 and 2001 used the agricultural household model for the examination of off-farm labour supply, production and consumption decision by US farmers, Singh and Janakiram (1986) used it for impact of government input and output policies on modern input use by Korean and Nigerian farmers. Strauss (1984) used it to estimate determinants of food consumption and caloric availability in Sierra Leone and found that, the effect of price policies on calorie intake are pronounced for low-income, and semi-subsistence farmers. Barnum and Squire (1979) also used the agricultural household models in Muda River Valley of Malaysia and found that production and marketed surplus responses to crop prices can be counterintuitive if market wages rise sufficiently. In their study to estimate the opportunity cost of migration, they found that true opportunity cost is about half of the marginal product of labour on the farm when allowances are made for the increase in supply of family labour remaining on the farm in response to reductions in household size, along with effects of migration on market wages. Pitt and Rosenzweig (1980) as in Singh et al (1986) used agricultural household model to study agricultural prices, food consumption and the health productivity of Indonesian farmers and concluded that illness of either spouse decreased significantly the amount of labour supply by farmers. They found that, there was little or no effect on farm profits exclusive of family opportunity cost.

Other recent studies applying the agricultural household models include those carried out by Rozelle, Taylor and deBrauw (1999) and deBrauw, Taylor and Rozelle (2003) to test the proposition[20] that, migrant remittances loosen various market constraints on rural household. Using rural Chinese data, they found significant negative effects of families' loss of labour to migration on farm production, incomes and crop yields but also found significant positive effects of remittances on all the variables. These findings contradict the assumptions of perfect markets and are evidence that rural Chinese households face imperfections in labour and credit markets. Agricultural households have also been known to be used for the analysis

[20] The proposition was put up by Taylor and Philip L. Martin, 2001 and papers of various authors in Stark, 1991) as reported by Taylor and Adelman, 2002

of environmental issues[21]. Edmeades et al 2004 also employed agricultural household model in their study of variety demand within the framework of an agricultural household models with attributes: the case of Banana in Uganda. Six variety demands were estimated in reduced form, each in terms of both plant counts ("absolute" or levels demand) and plant shares ("relative" demand). Two salient findings emerge from their analysis: 1) the determinants of both absolute and relative demands are variety-specific and cannot be generalized across groups of cultivars; and 2) the determinants of absolute and relative demand are not the same in sign or significance. From their findings they raise questions about commonly used econometric specifications in the adoption literature.

4.5 Model Specification

In the specification of the model, a number of assumptions are taken into consideration. It is assumed that, there are perfect markets for both labour and commodity markets as is always the case for most agricultural household models and that family and hired labour are substititutes. The assumption of perfect markets is made because there is no government intervention in the determination of prices for food commodities as well as other inputs in the Ghanaian economy. It is also assumed that, the household decision on consumption is dependent on production but not the other way round. This is because, the household as every rational being is set to maximize profit and would not only produce for consumption but also for profit. Therefore, the production is not dependent on the consumption decisions of the household. This leads us to a recursive model.

Demand and supply estimations

Singh et al 1986 (page 20) defined the commodity demand to be functions of commodity prices, full income and possibly household characteristics. Household characteristics such as the size is an important variable that affects consumption and therefore it is included in the model. From literature it is reported that, Lau, Lin and Yotopoulos (1978) also used household characteristics but they entered them as separate arguments into the utility

[21] Taylor and Adelman 2002 mentioned Brush, Taylor and Bellon (1992), Bellon and Taylor 1993; Dyer, 2001; Vandusen, 2000 Meng, Brush and Taylor 1998 as studies that have employed agricultural household models in environmental issues.

function. Barnum and Squire (1979) in their specification put household characteristics through full income.

This model includes the characteristic of household model in both the demand function as well as the income function. Therefore, the estimated model is specified as below;

$$X_r = X_r(P_r, P_{substitutes}, Y, HX, dummy) \quad \text{.....8}$$

Where

X_r	=	Household demand for rice
P_r	=	Own price of rice
$P_{substitutes}$	=	Prices of substitutes (e.g. Maize)
Y	=	Household Income
HX	=	Household characteristics (household size and level of education)
Dummy	=	dummy of region and district are included in the model

The demand for maize is also modeled as follows;

$$X_m = X_m(P_r, P_m, Y, HX, dummy) \quad \text{.....9}$$

Where

X_m	=	Household demand for maize

On the production side, Yotopoulos, Lau and Lin (1976) Kuroda and Fotopoulos (1978) estimated a profit function and associated input demand functions which are derived from a Cobb Douglas production function. Singh et al (1986) reported that, Barnum and Squire estimated the Cobb- Douglas production function directly. In this paper, the income is estimated directly using the various inputs prices, household characteristics etc. The income model is therefore modeled as

$$Y = Y(P_r, P_m, w, H_r, H_m, P_{fert}, Farmsize, HX, dummy) \quad \ldots\ldots 10$$

Where

w = Wage rate

H_r = Value Harvested of Rice

H_m = Value Harvested of Maize

P_{fert} = Price of Fertilizer

Farmsize = Farm Size

Dummy= Dummy of region and district are included in the model

In the income equation, the wage rate is not explicitly given and it is there derived from the data set as amount of money obtained from a given job divided by the number of hours worked.

These equations are then estimated simultaneously using three stage least squares (3SLS). The prices on the income model are interpreted as the price elasticities of supply. The three estimated equations are specified below using natural log;

$$\ln X_r = \alpha_0 + \alpha_r \ln P_r + \alpha_m \ln P_m + \alpha_Y \ln Y + \alpha_1 HHsize + \alpha_2 educ\max + dummy + u \quad \ldots\ldots 11$$

$$\ln X_m = \beta_0 + \beta_r \ln P_r + \beta_m \ln P_m + \beta_Y \ln Y + \beta_1 HHsize + \beta_2 educ\max + dummy + \varepsilon \quad \ldots\ldots 12$$

$$\ln Y = \delta_0 + \delta_r \ln P_r + \delta_m \ln P_m + \delta_1 \ln hrpay + \delta_{fert} P_{fert} + \delta_2 Farmsize + \delta_3 HHsize + \delta_4 educ\max + \delta_5 reg + dummy + \upsilon$$
$$\ldots\ldots 13$$

The income equation is a reduced form equation. The agricultural income is a function of production and the production is a function of fixed agricultural land and the prices of inputs. The profit of agricultural household is dependent on the total production. All these are modeled into the income equation above and therefore no need to model them separately. Considering the fact that locational differences could have an effect on the value or quantity demanded of the rice, a dummy of district is included in the model. It is worth noting that,

cash crops and other crops have an influence on the total incomes of households but due to lack of data, the model did not include them.

CHAPTER 5

5.1 Analysis of the Research Findings

Chapter five of this paper presents the findings and analysis of the paper. It describes the data used for the analysis and also presents the analysis of the econometric results.

5.1.1 The Data

The data for the study are obtained from the 1998/99 Ghana Living Standard Survey four (GLSS 4) conducted by the Ghana Statistical Services. The GLSS 4 is a nation-wide survey which collected detailed information on a variety of topics including demographic characteristics of population, education, health, employment and time use, migration, housing conditions, household agriculture and non farm businesses. It involved about 5,998 households and 26,411 individuals covering 300 enumeration areas across the entire country.

5.1.2 Descriptive Statistics

Table 5 below gives the descriptive statistics of the variables that are used in the analysis. The survey was divided into clusters which are indicated below to have about 6,002 observations. For the purpose of merging the data, a unique household number was created which has a variable name as nhhid. About 5,998 households were observed with an average household size of 4.4. In general, households are composed of 52% females and 48% males

Table 5 Gender Composition of Households

Sex	Freq.	Percent	Cum.
Female	13,818	52	52.32
Male	12,593	48	100
Total	26,411	100	

Source: Authors compilation from data

Considering the educational levels of households, it is reported in the table below that the average highest educated member in a household is 3 which is only to the level of vocational or commercial school. The educational status of household is very important as it influences their adoption of technologies especially in the agricultural sector.

Table 6 Descriptive Statistics

Variable	Obs	Variable Label	Mean	Std. Dev.	Min	Max
Clust	6002	Clust	4500.337	288.6218	4002	4999
Nhhid	5998		450054.5	28868.89	400201	499920
Nh	5998		10.87663	6.042519	1	25
LNTOTVALRice	6002		7.311184	3.770873	0	14.69225
LNTOTVALMa~e	6002		4.678517	4.8032	0	15.42495
LNtotvalha~R	6002		0.9724985	3.294442	0	15.53828
LNtotvalha~M	6002		6.203183	5.880934	0	17.28125
LNtotincome	6002		14.37377	2.707357	0	18.58214
LNpriceM	6002		0.2998372	1.33441	0	11.28978
LNpriceR	6002		5.85692	3.115489	0	11.97596
LNFpriceMi~g	6002		2.063058	4.050225	0	10.60597
LNhrpay	6002		8.163783	2.790205	0	14.59114
hhsize	6002	Household size	4.400367	2.632869	0	21
educmax	5998	Max Educ. level	2.897966	7.720799	0	96
hrswork	6002		1.613755	1.438621	0	6
Hrpay	6002	Pay per hour	17394.46	53145.09	0	2171949
labpay	6002		86451.08	260689	0	8686130
totvalMaize	6002	Expenditure on Maize	3982.633	12545.15	0	560000
totvalRice	6002	Expenditure on Rice	10512.11	33582.7	0	2403040
totqtycon~ce	6002		0.7579723	4.643425	0	97.5
totvalcon~ce	6002	Val of own produce consumed	1848.545	12209.44	0	370000
totqtycon~ze	6002		9.779469	42.05583	0	1840
totvalcon~ze	6002		9546.145	77495.64	0	5000000
TOTVALRice	6002	Total value of rice consumed	12360.65	35344.28	0	2403040
TOTVALMaize	6002	Total value of maize consumed	13528.78	78370.09	0	5000000
totharvkgM	6002		259.8605	1413.055	0	90000
totharseed~M	6002		6.601475	23.09013	0	800
totvalharvsM	6002		136319.4	620253.2	0	3.20E+07
totharvkgR	6002		51.18677	349.0238	0	14000
totharseed~R	6002		3.574642	22.8674	0	500
totvalharvsR	6002	Value harvested	27649.1	194659.9	0	5600000

		of Rice				
farmcd	6002		1.76108	1.889436	0	13
famsizeac	6002	Farm size	3.946038	11.22335	0	450
landsizeac~s	6002	Land size	5.280556	58.15139	0	3000
otherinc	5998	Other incomes	45925.64	365033.3	0	1.70E+07
remitinc	6002	Remittances	218672.1	731604.5	0	1.86E+07
Imprt	6002	Imputed input rental	43455.65	189343.7	0	8905820
nonfincome	6002	Non farm income	2139421	7076203	-1.14E+08	9.70E+07
agincome	6002	Farm income	1731971	3437136	-2.20E+07	9.73E+07
totemp	6002	Employment income	455940.2	1294814	0	1.89E+07
totincome	6002	Total income	4635355	7974742	-1.14E+08	1.18E+08
priceM	6002	Price of maize	40.28777	1047.766	0	80000
priceR	6002	Price of Rice	2638.766	12188.47	0	158888.9
FpriceMinibg	6002	Price of Fertilizer	4905.948	10279.11	0	40375
region	5998		0.5433478	0.498159	0	1
district	5998		6.174391	4.1451	1	18
Ez	5998		1.853618	0.7246898	1	3
Adult	5998		4.403301	2.631292	1	21
Sex	5998		0.4876931	0.2841187	0	1
educadult	5998		1.076417	2.607268	0	96
district1	5998		0.1333778	0.3400109	0	1
district2	5998		0.0733578	0.2607446	0	1
district3	5998		0.123041	0.3285117	0	1

Source: Compiled by the author from the regression summary results

5.1.3 Household Farm Size and Land Ownership

On the average, agricultural farm holding is about 4 acres per household whilst the average amount of size of land owned by households is about 5 acres. This therefore shows that expansion of farm size may be limited due to the amount of land available to households. However, the maximum farm size reported by the data is about 450 acres and maximum land size owned by household is 3,000. This shows the disparities in the ownership of land in Ghana. Generally, there is communal ownership of land in Ghana. However, land can be leased for other purposes for the period of 99 years for Ghanaian citizens and 50 years for non Ghanaians (the Constitution of the Republic of Ghana, 1992). Even though these periods

of leases are renewable after expiration, MOFA, 2002 identified the whole land tenure system in Ghana as a hindrance to agricultural development. For example the White farmers in Zimbabwe wanted to relocate to Ghana after the land distribution and redistribution in Zimbabwe but for the short periods of leases of land in Ghana, they had to relocate elsewhere. There is currently a land policy review in Ghana which is expected to address all the difficulties in the land acquisition and ownership.

5.1.4 Household Incomes and Prices for rice and Maize

The average annual incomes of households are about 4,638,446 cedis as can be seen in the table above. This is made up of farm incomes (37.36%), non farm incomes (46.15%), employment (9.85%), imputed input rental incomes (0.94%), remittances and other incomes (0.99%). For the rural communities, the most important component of their incomes is from the agricultural sector and therefore the development of agriculture in the country is very important for their livelihood.

From the data, the average price per kilo of rice was reported to be about 2,638 cedis whilst that of maize was just only about 40 cedis per kilo as at the time the survey was conducted. The pricing of agricultural produce according to theory is very important as it serves as an incentive (increase price) and at the same time a disincentive (low prices) for farmers.

5.2 Results

The results of the three stages least square are presented below in table 6. The first column presents the variable; the second presents the coefficient whilst the last column presents the standard errors.

Table 7 3SLS Results

Equation	Parms	RMSE	"R-sq"	Chi2	P
LNTOTVALRice	22	3.723288	0.0231	266.48	0.0000
LNTOTVALMa~e	22	4.508066	0.1190	810.71	0.0000
LNtotincome	25	2.586802	0.0700	453.32	0.0000
Demand for Rice					
Variable		**Coefficient (Elasticities)**		**Standard Error**	
LNTOTVALRice					
LNpriceR		0.0325756*		0.0176855	
LNpriceM		0.0281325		0.0406751	
LNtotincome		0.2160718 **		0.0877837	
Hhsize		0.2296531***		0.0217694	
educmax		0.0140334 **		0.0062732	
District 1		-0.3261732		0.6068571	
District 2		-0.4582513		0.6231405	
District 3		-0.399844		0.6095432	
District 4		-0.1055272		0.6161196	
District 5		-0.7192691		0.6183121	
District 6		-0.5270849		0.6188557	
District 7		-1.035935		0.6311169	
District 8		-1.072494*		0.6364911	
District 9		-0.5658736		0.6322934	
District 10		-0.6514595		0.6136701	
District 11		-0.9935334		0.6583989	
District 12		-1.250876 **		0.6314044	
District 13		-1.938725***		0.6860056	
District 14		-1.003912		0.6828133	
District 15		-1.557432**		0.6884271	
District 16		-0.6253624		0.8354872	
District 18		0.5979742		0.8347082	
Constant		3.565011**		1.397504	
Demand for Maize					
LNTOTVALMaize					

LNpriceR	0.1646023***	0.0214132
LNpriceM	0.3406345 ***	0.0492484
LNtotincome	0.0193318	0.1062863
Hhsize	0.3842531***	0.0263579
Educmax	0.0096434	0.0075954
District 1	2.264901***	0.7347677
District 2	3.226619 ***	0.7544832
District 3	4.170103 ***	0.7380199
District 4	4.019003 ***	0.7459825
District 5	3.705865 ***	0.7486371
District 6	5.031022 ***	0.7492953
District 7	3.547293 ***	0.7641408
District 8	4.278037 ***	0.7706477
District 9	5.904958 ***	0.7655653
District 10	2.987585 ***	0.7430166
District 11	5.28223 ***	0.7971732
District 12	3.65452 ***	0.7644889
District 13	5.556763 ***	0.8305987
District 14	1.947047 **	0.8267336
District 15	2.539221 ***	0.8335306
District 16	8.56426 ***	1.011587
District 18	4.875463 ***	1.010644
Constant	-2.152441	1.692063
Income Model		
LNtotincome		
LNpriceR	0.0049311	0.0125947
LNpriceM	0.0430827	0.0282516
LNhrpay	0.1890768***	0.0121707
famsizeac	0.0095722***	0.0030391
LNFpriceMi~g	8.47e-06 **	3.47e-06
Hhsize	0.1151094 ***	0.0130816
Educmax	0.0001003	0.0043597
Region	0.0369736	0.0719229
District 1	0.2276352	0.4250296
District 2	-0.3566232	0.4334385

District 3	-0.1071709	0.4258925
District 4	-0.5986066	0.4287627
District 5	0.1159089	0.4331067
District 6	-0.34199	0.4312034
District 7	-0.0065367	0.442196
District 8	-0.3854643	0.4437332
District 9	0.1055124	0.4432744
District 10	-0.1669122	0.428686
District 11	0.3290902	0.4628321
District 12	-0.3576844	0.4403759
District 13	-0.5920592	0.4754173
District 14	-0.3793537	0.4797166
District 15	-0.664942	0.4807755
District 17	0.1967312	0.5839186
District 18	-0.217087	0.5813306
Constant	12.36141	0.4462834

Source: Authors regression results

Significance Levels: *, **, *** indicate significance at the 10%, 5% and 1% levels respectively

5.2.1 The Household Demand for Rice

The results for the demand for rice show very small magnitudes of both positive and negative elasticities. Except for some of the dummies, all the major variables are inelastic. Only own price elasticity, household income, household size and maximum education level were found to be significant at 10%, 5%, 1% and 5% respectively. There were also some significant dummy variables reported for districts 8 (10%), 12 (5%), 13(1%) and 15 (5%).

The signs of the coefficients of the variables are interesting especially that for the own price of rice. It is known in economic theory that, own price elasticity is negatively related to quantities consumed which means that, as the price of a commodity increases, less of it is demanded. However, the result of this model goes contrary to the standard economic theory. As can be seen in the table above, the price of rice is positively related to the quantity demanded of it. This suggests that, as the price of rice increases, more of it is demanded. The own price elasticity of rice is 0.032 which means that, a 1% increase in the price of rice will lead to a 0.032% increase in the consumption of rice. That is a less than proportionate

increase in consumption. The elasticity is however very small though significant. This unexpected results can be explained by the fact that, as price increases, the profit made by agricultural households also increases and as profit increases, the demand for the commodity increases. This occurs when the profit effect outweighs the other effects (price effects). But from the small size of the coefficient, it means the welfare effects for producers are very marginal and therefore any reduction in price will completely erode the welfare effects and eventually hurt them. Similar results were also obtained by researchers as reported by Singh, Squire and Strauss (1986). Out of seven studies undertaken, four of them had positive own price elasticities whilst the other three had negative own price elasticities.

As expected, the cross price elasticity of maize is positive (0.028). This means that a 1% increase in the price of maize would lead to a 0.028% increase in the consumption of rice. Comparing the elasticities of the two prices, It means even still with the increase in the price of rice, the consumption of rice will be more responsive to its own price than maize. Comparing the two elasticities. This conforms to economic theory. Rational consumers will certainly demand a substitute that may give similar utility as the expensive good. However, the elasticity was not significant even at 10% significance level.

Similarly and as expected, the income elasticity of rice is positive and significant at 5%. What it means is that a 1% increase in household income will lead to about a 0.22% increase in the consumption of rice. Any policy that therefore increases the income of households will have a positive impact on the consumption of rice. Increases in prices invariably lead to increases in incomes and as such the profit effect comes into play to yield positive elasticity. This is further supported by the positive own price reported in the table above.

The household size as well as the maximum level of education also have positive relationship with the consumption of rice in Ghana. A 1% increase in household size leads to a 0.21% increases in the consumption of rice. This is because, as the number of household increases, more quantities of rice are required to feed them. Also, the increased household could increase production of the rice as they may be used as family labour in the production process. Household may therefore increase production as well as consumption. Increases in

the maximum level of education as indicated also leads to positively significant increases in consumption. This could be due to the fact that, educated folks especially in the cities are very busy and therefore would not have much time to cook traditional meals. The ease with which rice is cooked could also partly account for this. The dummy variables were all (except one – District 18) were found to be negatively related to the consumption of rice.

The constant elasticity was found to be positive and greater than all the elasticities of all the variables considered. This means that, keeping all other variables constant, rice will still be consumed by households.

5.2.2 The Household Demand for Maize

The demand for maize as indicated in the table 7 above also showed a positive own price elasticity. This means that, an increase in the price of maize by 1% will lead to increase in the consumption of maize by 0.34%. This increment is much less responsive to the increment in the price. As explained above in the case of rice, it means that, the profit effect from the production of maize is higher than that of the price effect. This is as a result of the fact that, agricultural households are both producers and consumers and therefore they suffer/benefit from both effects of price increases. The price elasticity of rice is also found to be positive and significant at 1% significant level. However, comparing the own price elasticity of maize and the price elasticity of rice, it is observed that, despite the increases in the price of rice, its consumption will be more than that of rice. Income is also found to have a positive effect on the consumption of maize even though the effect is insignificant. Similarly, household size as well as the maximum educational level are also positively related to the consumption of rice, though the elasticity for maximum educational level is insignificant. As reported in the table, the dummies were all found to be positive and many of them being significant.

5.2.3 Household Income model

As expected of economic theory, increases in prices of commodities will lead to increases in incomes of households. This is because, as the price increases, the agricultural household will be motivated enough to increase production and as production increases, income increases.

Singh et al have however hinted that, increases in the prices could lead to decreases in incomes as household will seek more leisure than working on the farm to increase production. Both prices of rice and maize were found to have positive influence on incomes even though they are both insignificant. The magnitudes are also very low. The household incomes are sluggishly responsive to prices of rice and maize. This could happen if the resulting increases in the prices of other inputs is higher than of the produce. In this case the profit effect will be very marginal.

Surprisingly, the hourly pay was found to have positive relationship with incomes. The wage elasticity was found to 0.189 and significant at 1%. As agricultural households can trade their family labour, it is possible that with an increase in the wage rate, they can decide to hire out their labour to increase incomes or they substitute much of their family labour for hired labour. In the case where they hire out their labour, they will receive higher wages and thus higher incomes. On the other hand, when they use family labour for production, they lower the cost of production thus increasing profits and incomes. Theoretically, increases in agricultural wages are expected to affect incomes negatively as they increase the cost of production.

The issue of the use of household family labour for increases in incomes is further supported by the fact that, a 1% increase in household size increases household by 0.12%. Even though the magnitude is very small, it is very significant at 1% significant level. An increase in household size makes more labour available for agriculture production. However, responsiveness is very low. Considering the farm size, the results show a very low elasticity of 0.009 which means that, an increase of the farm size by 1% will lead to an increase in incomes by just only 0.009%. One expected a higher responsiveness of incomes to increases in farm size. This might be due to lack of appropriate technologies such as the use of improved varieties, fertilizers etc to increase production.

Input prices such as fertilizer was expected to have a negative effect on incomes. However, the results showed a positive relation with a significance level of about 5%. Generally, it is expected the prices of agricultural inputs will affect production and incomes negatively

because they add on to production cost. For the case of fertilizer, it could be due to the limited usage of that resulted in the in the positive outcome.

CHAPTER 6

CONCLUSIONS AND POLICY IMPLICATION

Generally, increases in tariffs often lead to increases in prices. Therefore to protect certain sectors of the economy, governments often use trade instruments such as tariffs. The theory indicates that producers are responsive to these increases in prices. That is to say producers will supply more of a commodity when its price increases.

The rice industry in Ghana is faced with lots of import surges and many think that, the inability of the country to achieve self-sufficient is due to the imports. Therefore the debate has been to protect the industry against imports by the use of tariffs in order to attain self-sufficiency. This paper therefore uses the agricultural household model to estimate the elasticities of the demand and supply of rice in Ghana which are used to explain the effect of the increases in prices on the household. The agricultural household is both a consumer and a producer and therefore increases in the price of rice will affect them differently.

The results presented in chapter 5 above indicate that, the price elasticity of demand for rice is positive. As explained in the analysis, this is due to the fact that, the profit effect is higher than the price effect. (See equation 7 of the theoretical model for the composition). The profit effect is however, so marginal on consumption. For example, a 1% increase in the own price of rice will lead to only a 0.032% increases in the consumption. On the other hand, a fall in the price of rice, will lead to a fall in the consumption of rice by household. This therefore means that, any reduction in the price of rice will lead to the erosion of the marginal welfare effects that farmers might have been enjoying. Any policy interested in the welfare of the agricultural household would therefore increase prices to further increase their welfare. However, the increase in price of an important food staple like rice will obviously hurt the non-farm households that are net consumers. From the theory of infant industry, such welfare loses are temporal as there will be spillover effect form the agricultural households. There will be high demands for hired labour to increase production to which the non farm

households can be employed. Moreover, as the prices increase, producers will produce more rice and eventually rice prices will stabilize for the benefit of all.

It is in the interest of the agricultural household that policy geared towards making importation unattractive is persued. Apart from the tariffs motivating the households to increase production, the government will also raise revenue from such tariffs. This revenue could be re-channeled for the development of the domestic rice industry. However, considering the fact that this is a short term measure to decrease rice imports and to increase domestic production, it is recommended further studies be conducted on the long term cost of protection.

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APPENDIX A

COST OF PRODUCTION OF RICE

(a) Rice Cost of Production

Cost Per acre of land	Ejusu-Juaben Cost	Tolon Kumbungu Cost	Gomoa Cost	Average
Labour cost per acre 2002	1,100,000	**1,300,000**	1,550,000	1,383,000
Labour cost per acre 2003	1,300,000	1,350,000	1,650,000	1,483,000
Labor cost per acre 2004	1,500,000	1,500,000	1,700,000	1,766,000
Irrigation cost per acre 2002	300,000	**100**	533,333	277,811
Irrigation cost per acre 2003	200,000	75	533,333	244,469
Irrigation cost per acre 2004	533,333	16,667	533,333	361,111
Fertilizer cost per acre 2002	820,000	**1,750,000**	1,108,000	1,282,666
Fertilizer cost per acre 2003	1,150,000	1,800,000	1,097,500	3,149,166
Fertilizer cost per acre 2004	1,150,000	1,680,000	1,330,000	1,386,666
Seed cost per acre 2002	200,000	**540,000**	172,000	304,000
Seed cost per acre 2003	266,667	720,000	229,333	405,333
Seed cost per acre 2004	200,000	540,000	172,000	304,000
Agrochemicals cost per acre 2002	100,000	**240,000**	324,000	221,333
Agrochemicals cost per acre 2003	120,000	300,000	428,100	282,700
Agrochemicals cost per acre 2004	140,000	360,000	396,000	298,666
Production cost per acre 2002	**2,520,000**	**3,830,100**	**3,687,333**	**2,713,144**
Production cost per acre2003	**3,036,667**	**4,470,075**	**3,938, 266**	**5,565,002**
Production cost per acre 2004	**3,523,333**	**4,596,667**	**4,231,333**	**3,814,785**

Source: Writers modification of Assuming-Brempong (2006)

APPENDIX B

Table 5: Descriptive Statistics

Variable	Obs	Variable Label	Mean	Std. Dev.	Min	Max
Clust	6002	Clust	4500.337	288.6218	4002	4999
Nhhid	5998		450054.5	28868.89	400201	499920
Nh	5998		10.87663	6.042519	1	25
LNTOTVALRice	6002		7.311184	3.770873	0	14.69225
LNTOTVALMa~e	6002		4.678517	4.8032	0	15.42495
LNtotvalha~R	6002		0.9724985	3.294442	0	15.53828
LNtotvalha~M	6002		6.203183	5.880934	0	17.28125
LNtotincome	6002		14.37377	2.707357	0	18.58214
LNpriceM	6002		0.2998372	1.33441	0	11.28978
LNpriceR	6002		5.85692	3.115489	0	11.97596
LNFpriceMi~g	6002		2.063058	4.050225	0	10.60597
LNhrpay	6002		8.163783	2.790205	0	14.59114
Hhsize	6002		4.400367	2.632869	0	21
educmax	5998		2.897966	7.720799	0	96
Hrswork	6002		1.613755	1.438621	0	6
Hrpay	6002	Pay per hour	17394.46	53145.09	0	2171949
Labpay	6002		86451.08	260689	0	8686130
totvalMaize	6002	Expenditure on Maize	3982.633	12545.15	0	560000
totvalRice	6002	Expenditure on Rice	10512.11	33582.7	0	2403040
totqtycon~ce	6002		0.7579723	4.643425	0	97.5
totvalcon~ce	6002	Val of own produce consumed	1848.545	12209.44	0	370000
totqtycon~ze	6002		9.779469	42.05583	0	1840
totvalcon~ze	6002		9546.145	77495.64	0	5000000
TOTVALRice	6002	Total value of rice consumed	12360.65	35344.28	0	2403040
TOTVALMaize	6002	Total value of maize consumed	13528.78	78370.09	0	5000000
totharvkgM	6002		259.8605	1413.055	0	90000
totharseed~M	6002		6.601475	23.09013	0	800
totvalharvsM	6002		136319.4	620253.2	0	3.20E+07
totharvkgR	6002		51.18677	349.0238	0	14000
totharseed~R	6002		3.574642	22.8674	0	500
totvalharvsR	6002	Value harvested	27649.1	194659.9	0	5600000

		of Rice				
Farmcd	6002		1.76108	1.889436	0	13
famsizeac	6002	Farm size	3.946038	11.22335	0	450
qownland	6002		1.097634	0.8479453	0	2
landsizeac~s	6002	Land size	5.280556	58.15139	0	3000
Otherinc	5998	Other incomes	45925.64	365033.3	0	1.70E+07
Remitinc	6002	Remittances	218672.1	731604.5	0	1.86E+07
Imprt	6002	Imputed input rental	43455.65	189343.7	0	8905820
nonfincome	6002	Non farm income	2139421	7076203	-1.14E+08	9.70E+07
agincome	6002	Farm income	1731971	3437136	-2.20E+07	9.73E+07
Totemp	6002	Employment income	455940.2	1294814	0	1.89E+07
totincome	6002	Total income	4635355	7974742	-1.14E+08	1.18E+08
priceM	6002	Price of maize	40.28777	1047.766	0	80000
priceR	6002	Price of Rice	2638.766	12188.47	0	158888.9
FpriceMinibg	6002	Price of Fertilizer	4905.948	10279.11	0	40375
Region	5998		0.5433478	0.498159	0	1
District	5998		6.174391	4.1451	1	18
Ez	5998		1.853618	0.7246898	1	3
Adult	5998		4.403301	2.631292	1	21
Sex	5998		0.4876931	0.2841187	0	1
educadult	5998		1.076417	2.607268	0	96
district1	5998		0.1333778	0.3400109	0	1
district2	5998		0.0733578	0.2607446	0	1
district3	5998		0.123041	0.3285117	0	1
district4	5998		0.1167056	0.3210959	0	1
district5	5998		0.0733578	0.2607446	0	1
district6	5998		0.0833611	0.2764503	0	1
district7	5998		0.0500167	0.2179975	0	1
district8	5998		0.0466822	0.2109749	0	1
district9	5998		0.0466822	0.2109749	0	1
district10	5998		0.0933645	0.2909667	0	1
district11	5998		0.0266756	0.1611468	0	1
district12	5998		0.0533511	0.2247514	0	1
district13	5998		0.0200067	0.1400345	0	1
district14	5998		0.0200067	0.1400345	0	1
district15	5998		0.0200067	0.1400345	0	1
district16	5998		0.0066689	0.0813973	0	1

district17	5998	0.0066689	0.0813973	0	1
district18	5998	0.0066689	0.0813973	0	1

APPENDIX C

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. tab district, gen(district)

District	Freq.	Percent	Cum.
1	800	13.34	13.34
2	440	7.34	20.67
3	738	12.30	32.98
4	700	11.67	44.65
5	440	7.34	51.98
6	500	8.34	60.32
7	300	5.00	65.32
8	280	4.67	69.99
9	280	4.67	74.66
10	560	9.34	83.99
11	160	2.67	86.66
12	320	5.34	92.00
13	120	2.00	94.00
14	120	2.00	96.00
15	120	2.00	98.00
16	40	0.67	98.67
17	40	0.67	99.33
18	40	0.67	100.00
Total	5,998	100.00	

Three-stage least squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
LNTOTVALRice	5998	22	3.723288	0.0231	266.48	0.0000
LNTOTVALMa~e	5998	22	4.508066	0.1190	810.71	0.0000
LNtotincome	5998	25	2.586802	0.0700	453.32	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
LNTOTVALRice |						
LNpriceR |	.0325756	.0176855	1.84	0.065	-.0020874	.0672386
LNpriceM |	.0281325	.0406751	0.69	0.489	-.0515892	.1078543
LNtotincome |	.2160718	.0877837	2.46	0.014	.0440189	.3881246
hhsize |	.2296531	.0217694	10.55	0.000	.1869858	.2723204
educmax |	.0140334	.0062732	2.24	0.025	.0017382	.0263285
district1 |	-.3261732	.6068571	-0.54	0.591	-1.515591	.8632448
district2 |	-.4582513	.6231405	-0.74	0.462	-1.679584	.7630816
district3 |	-.399844	.6095432	-0.66	0.512	-1.594527	.7948387
district4 |	-.1055272	.6161196	-0.17	0.864	-1.313099	1.102045
district5 |	-.7192691	.6183121	-1.16	0.245	-1.931138	.4926003
district6 |	-.5270849	.6188557	-0.85	0.394	-1.74002	.68585
district7 |	-1.035935	.6311169	-1.64	0.101	-2.272901	.2010317
district8 |	-1.072494	.6364911	-1.69	0.092	-2.319994	.1750051
district9 |	-.5658736	.6322934	-0.89	0.371	-1.805146	.6733987
district10 |	-.6514595	.6136701	-1.06	0.288	-1.854231	.5513117
district11 |	-.9935334	.6583989	-1.51	0.131	-2.283972	.2969048
district12 |	-1.250876	.6314044	-1.98	0.048	-2.488406	-.0133461
district13 |	-1.938725	.6860056	-2.83	0.005	-3.283271	-.5941789
district14 |	-1.003912	.6828133	-1.47	0.141	-2.342201	.3343779
district15 |	-1.557432	.6884271	-2.26	0.024	-2.906724	-.2081394
district16 |	-.6253624	.8354872	-0.75	0.454	-2.262887	1.012162
district17 |	(dropped)					
district18 |	.5979742	.8347082	0.72	0.474	-1.038024	2.233972
_cons |	3.565011	1.397504	2.55	0.011	.8259543	6.304069
LNTOTVALMa~e |						
LNpriceR |	.1646023	.0214132	7.69	0.000	.1226332	.2065715
LNpriceM |	.3406345	.0492484	6.92	0.000	.2441094	.4371596
LNtotincome |	.0193318	.1062863	0.18	0.856	-.1889855	.2276492
hhsize |	.3842531	.0263579	14.58	0.000	.3325926	.4359136
educmax |	.0096434	.0075954	1.27	0.204	-.0052432	.0245301
district1 |	2.264901	.7347677	3.08	0.002	.8247832	3.70502
district2 |	3.226619	.7544832	4.28	0.000	1.747859	4.705379
district3 |	4.170103	.7380199	5.65	0.000	2.723611	5.616596
district4 |	4.019003	.7459825	5.39	0.000	2.556904	5.481102
district5 |	3.705865	.7486371	4.95	0.000	2.238564	5.173167
district6 |	5.031022	.7492953	6.71	0.000	3.56243	6.499614
district7 |	3.547293	.7641408	4.64	0.000	2.049604	5.044981
district8 |	4.278037	.7706477	5.55	0.000	2.767595	5.788479
district9 |	5.904958	.7655653	7.71	0.000	4.404477	7.405438

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 district10 |  2.987585   .7430166     4.02   0.000      1.5313    4.443871
 district11 |   5.28223   .7971732     6.63   0.000    3.719799     6.84466
 district12 |   3.65452   .7644889     4.78   0.000    2.156149     5.15289
 district13 |   5.556763  .8305987     6.69   0.000    3.928819    7.184706
 district14 |   1.947047  .8267336     2.36   0.019    .3266788    3.567415
 district15 |   2.539221  .8335306     3.05   0.002    .9055315    4.172911
 district15 |  (dropped)
 district16 |   8.56426   1.011587     8.47   0.000    6.581586    10.54694
 district17 |  (dropped)
 district18 |   4.875463  1.010644     4.82   0.000    2.894637    6.856289
      _cons |  -2.152441  1.692063    -1.27   0.203   -5.468824    1.163942
------------+----------------------------------------------------------------
LNtotincome |
    LNpriceR |   .0049311  .0125947     0.39   0.695    -.019754    .0296163
    LNpriceM |   .0430827  .0282516     1.52   0.127   -.0122893    .0984548
     LNhrpay |   .1890768  .0121707    15.54   0.000    .1652226    .2129311
   famsizeac |   .0095722  .0030391     3.15   0.002    .0036158    .0155286
FpriceMinibg |   8.47e-06  3.47e-06     2.44   0.015    1.67e-06    .0000153
      hhsize |   .1151094  .0130816     8.80   0.000    .0894699    .1407489
     educmax |   .0001003  .0043597     0.02   0.982   -.0084446    .0086452
      region |   .0369736  .0719229     0.51   0.607   -.1039926    .1779399
   district1 |   .2276352  .4250296     0.54   0.592   -.6054075    1.060678
   district2 |  -.3566232  .4334385    -0.82   0.411   -1.206147    .4929008
   district3 |  -.1071709  .4258925    -0.25   0.801   -.9419048    .7275631
   district4 |  -.5986066  .4287627    -1.40   0.163   -1.438966    .2417528
   district5 |   .1159089  .4331067     0.27   0.789   -.7329646    .9647823
   district6 |   -.34199   .4312034    -0.79   0.428   -1.187133    .5031532
   district7 |  -.0065367   .442196    -0.01   0.988    -.873225    .8601516
   district8 |  -.3854643  .4437332    -0.87   0.385   -1.255165    .4842368
   district9 |   .1055124  .4432744     0.24   0.812   -.7632894    .9743143
  district10 |  -.1669122   .428686    -0.39   0.697   -1.007121    .6732968
  district11 |   .3290902  .4628321     0.71   0.477    -.578044    1.236224
  district12 |  -.3576844  .4403759    -0.81   0.417   -1.220805    .5054364
  district13 |  -.5920592  .4754173    -1.25   0.213    -1.52386    .3397417
  district14 |  -.3793537  .4797166    -0.79   0.429   -1.319581    .5608736
  district15 |   -.664942  .4807755    -1.38   0.167   -1.607245    .2773607
  district16 |  (dropped)
  district17 |   .1967312  .5839186     0.34   0.736   -.9477283    1.341191
  district18 |   -.217087  .5813306    -0.37   0.709   -1.356474     .9223
      _cons |   12.36141  .4462834    27.70   0.000    11.48671    13.23611
------------------------------------------------------------------------------
Endogenous variables:  LNTOTVALRice LNTOTVALMaize LNtotincome
Exogenous variables:  LNpriceR LNpriceM hhsize educmax district1 district2
    district3 district4 district5 district6 district7 district8 district9
    district10 district11 district12 district13 district14 district15
    district16 district17 district18 LNhrpay famsizeac FpriceMinibg region
```

```
-------------------------------------------------------------------------------

. do "C:\DOCUME~1\ADMINI~1\LOCALS~1\Temp\STD030000.tmp"

. sum

    Variable |     Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
       clust |    6002    4500.337    288.6218      4002       4999
       nhhid |    5998    450054.5    28868.89    400201     499920
          nh |    5998    10.87663    6.042519         1         25
LNTOTVALRice |    6002    7.311184    3.770873         0   14.69225
LNTOTVALMa~e |    6002    4.678517      4.8032         0   15.42495
-------------+--------------------------------------------------------
LNtotvalha~R |    6002    .9724985    3.294442         0   15.53828
LNtotvalha~M |    6002    6.203183    5.880934         0   17.28125
 LNtotincome |    6002    14.37377    2.707357         0   18.58214
   LNpriceM |    6002    .2998372     1.33441         0   11.28978
   LNpriceR |    6002     5.85692    3.115489         0   11.97596
-------------+--------------------------------------------------------
LNFpriceMi~g |    6002    2.063058    4.050225         0   10.60597
    LNhrpay |    6002    8.163783    2.790205         0   14.59114
     hhsize |    6002    4.400367    2.632869         0         21
    educmax |    5998    2.897966    7.720799         0         96
    hrswork |    6002    1.613755    1.438621         0          6
-------------+--------------------------------------------------------
      hrpay |    6002    17394.46    53145.09         0    2171949
     labpay |    6002    86451.08      260689         0    8686130
 totvalMaize |    6002    3982.633    12545.15         0     560000
  totvalRice |    6002    10512.11     33582.7         0    2403040
totqtycon~ce |    6002    .7579723    4.643425         0       97.5
-------------+--------------------------------------------------------
totvalcon~ce |    6002    1848.545    12209.44         0     370000
totqtycon~ze |    6002    9.779469    42.05583         0       1840
totvalcon~ze |    6002    9546.145    77495.64         0    5000000
 TOTVALRice |    6002    12360.65    35344.28         0    2403040
 TOTVALMaize |    6002    13528.78    78370.09         0    5000000
-------------+--------------------------------------------------------
  totharvkgM |    6002    259.8605    1413.055         0      90000
totharseed~M |    6002    6.601475    23.09013         0        800
totvalharvsM |    6002    136319.4    620253.2         0   3.20e+07
  totharvkgR |    6002    51.18677    349.0238         0      14000
totharseed~R |    6002    3.574642     22.8674         0        500
-------------+--------------------------------------------------------
totvalharvsR |    6002     27649.1    194659.9         0    5600000
      farmcd |    6002     1.76108    1.889436         0         13
```

```
  famsizeac |    6002   3.946038   11.22335        0      450
   qownland |    6002   1.097634   .8479453        0        2
landsizeac~s |    6002   5.280556   58.15139        0     3000
-------------+---------------------------------------------------------
   otherinc |    5998   45925.64   365033.3        0  1.70e+07
   remitinc |    6002   218672.1   731604.5        0  1.86e+07
      imprt |    6002   43455.65   189343.7        0  8905820
 nonfincome |    6002    2139421    7076203 -1.14e+08  9.70e+07
   agincome |    6002    1731971    3437136 -2.20e+07  9.73e+07
-------------+---------------------------------------------------------
    totemp |    6002   455940.2    1294814        0  1.89e+07
  totincome |    6002    4635355    7974742 -1.14e+08  1.18e+08
     priceM |    6002   40.28777   1047.766        0     80000
     priceR |    6002   2638.766   12188.47        0  158888.9
FpriceMinibg |    6002   4905.948   10279.11        0     40375
-------------+---------------------------------------------------------
     region |    5998   .5433478    .498159        0        1
   district |    5998   6.174391     4.1451        1       18
         ez |    5998   1.853618   .7246898        1        3
      adult |    5998   4.403301   2.631292        1       21
        sex |    5998   .4876931   .2841187        0        1
-------------+---------------------------------------------------------
  educadult |    5998   1.076417   2.607268        0       96
  district1 |    5998   .1333778   .3400109        0        1
  district2 |    5998   .0733578   .2607446        0        1
  district3 |    5998    .123041   .3285117        0        1
  district4 |    5998   .1167056   .3210959        0        1
-------------+---------------------------------------------------------
  district5 |    5998   .0733578   .2607446        0        1
  district6 |    5998   .0833611   .2764503        0        1
  district7 |    5998   .0500167   .2179975        0        1
  district8 |    5998   .0466822   .2109749        0        1
  district9 |    5998   .0466822   .2109749        0        1
-------------+---------------------------------------------------------
 district10 |    5998   .0933645   .2909667        0        1
 district11 |    5998   .0266756   .1611468        0        1
 district12 |    5998   .0533511   .2247514        0        1
 district13 |    5998   .0200067   .1400345        0        1
 district14 |    5998   .0200067   .1400345        0        1
-------------+---------------------------------------------------------
 district15 |    5998   .0200067   .1400345        0        1
 district16 |    5998   .0066689   .0813973        0        1
 district17 |    5998   .0066689   .0813973        0        1
 district18 |    5998   .0066689   .0813973        0        1

. des
```

Contains data from C:\Documents and Settings\Administrator\Desktop\Finally merged data-19-11-06.dta

obs:	6,002		
vars:	69	20 Nov 2006 09:52	
size:	2,052,684 (80.4% of memory free)		

variable name	storage type	display format	value label	variable label
clust	double	%10.0g		Enumeration Area number
nhhid	float	%9.0g		
nh	double	%10.0g		Household ID
LNTOTVALRice	float	%9.0g		
LNTOTVALMaize	float	%9.0g		
LNtotvalharvsR	float	%9.0g		
LNtotvalharvsM	float	%9.0g		
LNtotincome	float	%9.0g		
LNpriceM	float	%9.0g		
LNpriceR	float	%9.0g		
LNFpriceMinibg	float	%9.0g		
LNhrpay	float	%9.0g		
hhsize	long	%10.0g		(count) pid
educmax	double	%10.0g		(max) educlevel
hrswork	double	%10.0g		(mean) hrswork
hrpay	float	%9.0g		(mean) hrpay
labpay	double	%10.0g		(mean) labpay
totvalMaize	double	%9.0g		2 totvalexp
totvalRice	double	%9.0g		4 totvalexp
totqtyconsrice	double	%9.0g		1 totqtyconskg
totvalconsrice	double	%9.0g		1 totvalcons
totqtyconsmaize	double	%9.0g		3 totqtyconskg
totvalconsmaize	double	%9.0g		3 totvalcons
TOTVALRice	float	%9.0g		
TOTVALMaize	float	%9.0g		
totharvkgM	double	%9.0g		22 totharvkg
totharseedkgM	double	%9.0g		22 totharseedkg
totvalharvsM	double	%10.0g		22 totvalharvs
totharvkgR	double	%9.0g		23 totharvkg
totharseedkgR	double	%9.0g		23 totharseedkg
totvalharvsR	double	%10.0g		23 totvalharvs
farmcd	double	%10.0g		(sum) farmcd
famsizeac	double	%9.0g		(sum) famsizeac
qownland	double	%10.0g		HH own any land currently
landsizeacres	float	%9.0g		
otherinc	double	%10.0g		Other income

```
remitinc        double %10.0g                 Income from remittances
imprt           double %10.0g                 Actual and imputed rental incom
nonfincome      float  %9.0g
agincome        float  %9.0g
totemp          double %10.0g                 Income from employment
totincome       float  %9.0g
priceM          float  %9.0g                  (mean) priceM
priceR          float  %9.0g                  (mean) priceR
FpriceMinibg    double %10.0g                 (mean) price
region          double %10.0g                 Region
district        double %10.0g                 District
ez              double %10.0g                 Ecological zone of HH
adult           long   %9.0g                  (count) adult
sex             double %10.0g                 (mean) sex
educadult       float  %9.0g                  (mean) educadult
district1       byte   %8.0g                  district==  1.0000
district2       byte   %8.0g                  district==  2.0000
district3       byte   %8.0g                  district==  3.0000
district4       byte   %8.0g                  district==  4.0000
district5       byte   %8.0g                  district==  5.0000
district6       byte   %8.0g                  district==  6.0000
district7       byte   %8.0g                  district==  7.0000
district8       byte   %8.0g                  district==  8.0000
district9       byte   %8.0g                  district==  9.0000
district10      byte   %8.0g                  district== 10.0000
district11      byte   %8.0g                  district== 11.0000
district12      byte   %8.0g                  district== 12.0000
district13      byte   %8.0g                  district== 13.0000
district14      byte   %8.0g                  district== 14.0000
district15      byte   %8.0g                  district== 15.0000
district16      byte   %8.0g                  district== 16.0000
district17      byte   %8.0g                  district== 17.0000
district18      byte   %8.0g                  district== 18.0000
------------------------------------------------------------------------------
Sorted by:
     Note:  dataset has changed since last saved


Three-stage least squares regression
----------------------------------------------------------------------
Equation        Obs  Parms      RMSE   "R-sq"     chi2      P
----------------------------------------------------------------------
LNTOTVALRice   5998     22  3.723288   0.0231   266.48   0.0000
LNTOTVALMa~e   5998     22  4.508066   0.1190   810.71   0.0000
LNtotincome    5998     25  2.586802   0.0700   453.32   0.0000
----------------------------------------------------------------------
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
LNTOTVALRice						
LNpriceR	.0325756	.0176855	1.84	0.065	-.0020874	.0672386
LNpriceM	.0281325	.0406751	0.69	0.489	-.0515892	.1078543
LNtotincome	.2160718	.0877837	2.46	0.014	.0440189	.3881246
hhsize	.2296531	.0217694	10.55	0.000	.1869858	.2723204
educmax	.0140334	.0062732	2.24	0.025	.0017382	.0263285
district1	-.3261732	.6068571	-0.54	0.591	-1.515591	.8632448
district2	-.4582513	.6231405	-0.74	0.462	-1.679584	.7630816
district3	-.399844	.6095432	-0.66	0.512	-1.594527	.7948387
district4	-.1055272	.6161196	-0.17	0.864	-1.313099	1.102045
district5	-.7192691	.6183121	-1.16	0.245	-1.931138	.4926003
district6	-.5270849	.6188557	-0.85	0.394	-1.74002	.68585
district7	-1.035935	.6311169	-1.64	0.101	-2.272901	.2010317
district8	-1.072494	.6364911	-1.69	0.092	-2.319994	.1750051
district9	-.5658736	.6322934	-0.89	0.371	-1.805146	.6733987
district10	-.6514595	.6136701	-1.06	0.288	-1.854231	.5513117
district11	-.9935334	.6583989	-1.51	0.131	-2.283972	.2969048
district12	-1.250876	.6314044	-1.98	0.048	-2.488406	-.0133461
district13	-1.938725	.6860056	-2.83	0.005	-3.283271	-.5941789
district14	-1.003912	.6828133	-1.47	0.141	-2.342201	.3343779
district15	-1.557432	.6884271	-2.26	0.024	-2.906724	-.2081394
district16	-.6253624	.8354872	-0.75	0.454	-2.262887	1.012162
district17	(dropped)					
district18	.5979742	.8347082	0.72	0.474	-1.038024	2.233972
_cons	3.565011	1.397504	2.55	0.011	.8259543	6.304069
LNTOTVALMa~e						
LNpriceR	.1646023	.0214132	7.69	0.000	.1226332	.2065715
LNpriceM	.3406345	.0492484	6.92	0.000	.2441094	.4371596
LNtotincome	.0193318	.1062863	0.18	0.856	-.1889855	.2276492
hhsize	.3842531	.0263579	14.58	0.000	.3325926	.4359136
educmax	.0096434	.0075954	1.27	0.204	-.0052432	.0245301
district1	2.264901	.7347677	3.08	0.002	.8247832	3.70502
district2	3.226619	.7544832	4.28	0.000	1.747859	4.705379
district3	4.170103	.7380199	5.65	0.000	2.723611	5.616596
district4	4.019003	.7459825	5.39	0.000	2.556904	5.481102
district5	3.705865	.7486371	4.95	0.000	2.238564	5.173167
district6	5.031022	.7492953	6.71	0.000	3.56243	6.499614
district7	3.547293	.7641408	4.64	0.000	2.049604	5.044981
district8	4.278037	.7706477	5.55	0.000	2.767595	5.788479
district9	5.904958	.7655653	7.71	0.000	4.404477	7.405438
district10	2.987585	.7430166	4.02	0.000	1.5313	4.443871

```
 district11 |  5.28223  .7971732    6.63  0.000    3.719799   6.84466
 district12 |  3.65452  .7644889    4.78  0.000    2.156149   5.15289
 district13 |  5.556763 .8305987    6.69  0.000    3.928819   7.184706
 district14 |  1.947047 .8267336    2.36  0.019    .3266788   3.567415
 district15 |  2.539221 .8335306    3.05  0.002    .9055315   4.172911
 district15 |  (dropped)
 district16 |  8.56426  1.011587    8.47  0.000    6.581586   10.54694
 district17 |  (dropped)
 district18 |  4.875463 1.010644    4.82  0.000    2.894637   6.856289
      _cons |  -2.152441 1.692063   -1.27  0.203   -5.468824   1.163942
------------+----------------------------------------------------------------
LNtotincome |
    LNpriceR |  .0049311  .0125947    0.39  0.695   -.019754    .0296163
    LNpriceM |  .0430827  .0282516    1.52  0.127   -.0122893   .0984548
     LNhrpay |  .1890768  .0121707   15.54  0.000    .1652226   .2129311
   famsizeac |  .0095722  .0030391    3.15  0.002    .0036158   .0155286
FpriceMinibg |  8.47e-06  3.47e-06    2.44  0.015    1.67e-06   .0000153
      hhsize |  .1151094  .0130816    8.80  0.000    .0894699   .1407489
     educmax |  .0001003  .0043597    0.02  0.982   -.0084446   .0086452
      region |  .0369736  .0719229    0.51  0.607   -.1039926   .1779399
   district1 |  .2276352  .4250296    0.54  0.592   -.6054075   1.060678
   district2 |  -.3566232 .4334385   -0.82  0.411   -1.206147   .4929008
   district3 |  -.1071709 .4258925   -0.25  0.801   -.9419048   .7275631
   district4 |  -.5986066 .4287627   -1.40  0.163   -1.438966   .2417528
   district5 |  .1159089  .4331067    0.27  0.789   -.7329646   .9647823
   district6 |  -.34199   .4312034   -0.79  0.428   -1.187133   .5031532
   district7 |  -.0065367 .442196    -0.01  0.988   -.873225    .8601516
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  district10 |  -.1669122 .428686    -0.39  0.697   -1.007121   .6732968
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  district12 |  -.3576844 .4403759   -0.81  0.417   -1.220805   .5054364
  district13 |  -.5920592 .4754173   -1.25  0.213   -1.52386    .3397417
  district14 |  -.3793537 .4797166   -0.79  0.429   -1.319581   .5608736
  district15 |  -.664942  .4807755   -1.38  0.167   -1.607245   .2773607
  district16 |  (dropped)
  district17 |  .1967312  .5839186    0.34  0.736   -.9477283   1.341191
  district18 |  -.217087  .5813306   -0.37  0.709   -1.356474    .9223
      _cons |  12.36141  .4462834   27.70  0.000    11.48671   13.23611
------------------------------------------------------------------------------
Endogenous variables:  LNTOTVALRice LNTOTVALMaize LNtotincome
Exogenous variables:  LNpriceR LNpriceM hhsize educmax district1 district2
    district3 district4 district5 district6 district7 district8 district9
    district10 district11 district12 district13 district14 district15
    district16 district17 district18 LNhrpay famsizeac FpriceMinibg region
------------------------------------------------------------------------------
```