Productivity and Competitiveness of Sorghum Production in Northern Ghana

A Policy Analysis Matrix Approach

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Abstract

A major element of low productivity at the farm level of smallholder farmers is high production costs which result in low competitiveness of the produce. Low produce prices, especially during harvests, also result in low returns to farmers. To help mitigate this problem in sorghum farming, the study sought to analyze the productivity and competitiveness of sorghum production in northern Ghana with particular reference to varieties produced for the brewery industry. A Policy Analysis Matrix (PAM) approach was used in the analysis. The PAM results showed that sorghum production in the study areas yielded profitable returns to land and management at social prices but not at private prices mainly because of low yields. The results also indicated differences in profitability for different areas. To make sorghum production sustainable, profit levels of farmers are critical. It is therefore recommended that the cost of production and output levels of farmers be taken into consideration in negotiating prices for farmers to at least break even.

Keywords: Sorghum, Profitability, Competitiveness, Investment Potential, Poverty Reduction.

Introduction

According to the 2008 World Bank Development Report agricultural growth has high potential in reducing poverty in developing countries. The main pathway out of poverty through agriculture, according to the report, is improving productivity, profitability and sustainability of smallholder farming. There have been significant reductions in poverty in Ghana between 1991 and 2006 as a whole but the reductions in the northern rural savanna areas (Northern, Upper East and Upper West Regions) have been very marginal and inequality has increased (GSS, 2007). This has been attributed to deterioration in productivity, profitability and sustainability of smallholder farming over time (Dittoh, 2005). It is evident that soils have generally become poorer and yields of staple crops have declined over time in the northern savanna areas (SRID, 2007). There is also evidence of poor price incentives and difficulties in getting secure markets for farm produce (ACDEP, 2007).

Another major reason advanced for the increasing poverty in northern Ghana, relative to the rest of the country, is the relative lack of cash crops (Dittoh, 2005). Cotton, sorghum, rice, groundnuts and soybeans have the potential of becoming major cash crops in northern Ghana. The productions of all these crops however face one problem or the other. Sorghum, the crop under this study, has great potential as a cash crop because its use in the brewery industry. Guinness Ghana Limited, one of the main breweries in the country, has indicated that it will require up to 7,000 metric tons of sorghum in the medium term. There is also the possibility of other breweries substituting sorghum for barley in the near future. Nigerian breweries depend almost solely on locally produced sorghum for the brewery industry. That points to the need to improve the productivity of sorghum for similar effects in Ghana. Al-Hassan and Jatoe (2002) noted that though sorghum has tremendous potential for the production of malt, numerous edaphic, physiologic and biotic constraints have led to very low productivity per unit area. Over 90% of Ghana's sorghum is produced in the Northern, Upper East and Upper West Regions (RUDEMA, 2006), most of which is used in local pito "breweries". The local market is, however, very limited and unorganized.

This paper reports on a research that compared the productivity and competitiveness of sorghum production in three sorghum producing areas in northern Ghana of different climatic conditions, vegetation and population densities by using a Policy Analysis Method (PAM) approach. It is by computing private and social profitability of production in different locations that one can be certain of areas of comparative advantage and thus investment potentials.

Study Area

As indicated earlier, the Northern Savanna Ecological Zone is the main sorghum producing area of Ghana. The zone comprises over one-third the area of Ghana. It is thus a wide area with variations in soils, microclimates, micro-economics and population densities. These peculiar characteristics of the different areas affect productivity and the degree of comparative advantage with regards to the production of different crops.

The research looked at the relative private and social profitability of sorghum production in the Garu-Tempane District in the Upper East Region, Sissala East District in the Upper West Region and Saboba District in the Northern Region. Garu-Tempane District is at the north-east corner of the country. Most of the district is in the Sudan Savanna Zone. It is densely populated (about 99 persons per square kilometer) and there is considerable pressure on the land. The main crops produced are cereals (millet, sorghum and maize) and grain legumes (groundnuts, beans and soybeans). The Sissala East District in contrast is relatively sparsely populated (about 12 persons per square kilometer) situated in the north-central part of Ghana. Though, almost along the same latitudes as Garu-Tempane District, it is in a Guinea Savanna Zone. The main crops produced in the district are also cereals (maize and sorghum) as well as groundnuts and cotton. The Saboba District is part of the north-eastern corridor of Ghana. It is however about 500 kilometers south of Garu-Tempane District. It is in the Guinea Savanna Zone but experiences much higher rainfall than the two other areas. It is an area that is well drained by the River Oti and its tributaries and is prone to flooding during the rainy season. The population density is also relatively high (about 80 persons per square kilometer). The main crops grown are yam, cassava, maize, sorghum and groundnuts. This is to stress the level of diversity that exists between the different districts.

Methods of Data Collection

Participant observations and key informant discussions with sorghum farmers and community leaders were used in the information gathering process to obtain mainly qualitative information with regards to the social arrangement for sorghum production, the benefits and the constraints faced. In addition, semi-structured questionnaires were administered to three hundred (300) sorghum farmers sampled from thirty (30) communities in the three districts for the purpose of obtaining quantitative production and marketing information. Checklists were also used to collect information from Savanna Farmers' Marketing Company (SFMC), a private company which acts as intermediary between sorghum farmers and processors; nucleus farmers (assisted by Technoserve, an NGO); traders of sorghum (market women); "pito" brewers; and Guinness Ghana Brewery Limited to estimate cost and returns at the marketing sector of the sorghum supply chain. Current and potential sorghum yields in the study area were obtained from the Statistics, Research and Information Department (SRID) of the Ministry of Food and Agriculture (MOFA).

Policy Analysis Matrix Approach to Competitiveness Analysis

Competitiveness may be stated as the degree to which sorghum producers achieve economically optimum returns, given available resources, techniques, policies, and prices. The policy analysis matrix approach is usually used to infer competitiveness.

Farm level profitability information is important in competitiveness analysis, and as such, the Policy Analysis Matrix (PAM) approach is undertaken here to determine how relatively profitable sorghum production is in the three selected areas. The PAM is a computational framework for measuring input use efficiency in production, comparative advantage among commodities, and the degree of government interventions. It was developed by Monke and Pearson (1989) and augmented by Masters and Winter-Nelson (1995) and several others. Table 1 is the basic format of the PAM.

Table 1: Format of the Policy Analysis Matrix (PAM)

	Revenues	Costs Tradable Domestic Inputs factors		Profits
Private prices Social prices Divergence and Policy transfer	A E I (A-E)	B F J (B-F)	C G K (C-G)	D(A-B-C) H(E-F-G) L (D-H)

Source: Monke and Pearson, 1989.

Where:

A = Private revenue	B = Private input cost	C = Private factor cost
D = Private profits	E = Social revenue	F = Social input cost
G = Social factor cost	H = Social profits	I = Output transfers
J = Input transfers	K = Factor transfers	L = Net transfers

As shown in Table 1, the PAM matrix consists of two accounting identities: the profitability identity and the divergence identity. The first row provides a measure of private profitability (D), defined as the difference between observed revenue (A) and costs (B+C) and indicates the competitiveness of the system given current technologies, policies, and prices for inputs and outputs. The profit levels of farmers show whether they are making normal returns or not as indicated below.

$D < 0 \rightarrow$ subnormal rate of return

$D = 0 \rightarrow$ normal returns level

$D > 0 \rightarrow$ super-normal returns

The second row of the PAM estimates the social profit (H). Social profits measure efficiency (comparative advantage) of the system. A positive social profit ($H > 0$) indicates that the area uses its resources efficiently and has a comparative advantage in the production of that commodity. A negative social profit ($H < 0$) however indicates that resources are being wasted in the agricultural system that could have been utilized more efficiently in other systems.

The third row of the PAM is the divergence identity and estimates the difference between private and social values of revenues, costs, and profits. These divergences are mostly due to policy interventions.

The PAM framework is also used to calculate important indicators for policy analysis. The most useful indicator is the domestic resource cost (DRC) ratio which reflects the relationship between the true cost of producing one unit of an item and the true cost of importing the alternative (Sadoulet and Jauvry, 1995). It is a ratio of the cost of domestic factors to the difference in revenues and cost of tradable inputs using social prices, (G/(E-F). The DRC value of less than 1 indicates that sorghum production is efficient and thus indicates that the nation has a comparative advantage in its production.

Several other indicators can also be calculated from the PAM. They include the nominal protection coefficient (NPC) for both outputs (NPCO) and inputs (NPCI), the effective protection coefficient (EPC), the private cost ratio (PCR), the subsidy ratio to producers (SRP) and others (Monke et al, 1989, Mohanty, Fang and Chaudhary 2003). These parameters are normally used to infer the impact of policy on productivity.

"The data requirements for constructing a PAM include yields, input requirements, and the market prices for inputs and outputs. Additional data such as transportation costs, port charges, storage costs, production subsidies, import/export tariffs, and exchange rates are also required to calculate social prices" (Mohanty, Fang and Chaudhary, 2004). In this study, PAM is constructed for sorghum production using information from the study area for the 2008 production year. Also, both fixed and operating costs are estimated in using the PAM method. In this study, however, all the costs, except that of land, were observed to be operating costs. It was also noted that land is not bought or rented in the study area. The main costs items that were thus considered included fertilizer and seed measured in kg/ha as tradable inputs, labor in person-days and capital in Ghana Cedis as domestic factors, where tradable inputs are those that can be traded across the border while domestic factors are those that do not have border prices.

The most difficult tasks for constructing a PAM are estimating social prices for outputs and inputs and decomposing inputs into their tradable and non-tradable components as pointed out by Yao (1997). For computing social prices for various commodities, including both outputs and inputs, world prices (c.i.f prices) which were collected from SRID (of MOFA) are used as the reference prices in the study. The minimum wage in Ghana for the 2008 working year is also used as the social cost of labor since production data was collected for the 2008 cropping year. According to Monke and associates al. (1989), decomposing all input costs is tedious and has no significant effect on results. As such, inputs such as land, farm capital depreciation, animal power, manure, and labor are assumed to be non-tradable in this study. Profitability is also defined here to mean returns to land and management (rather than only returns to management) as suggested by Pearson, Gotsch and Bahri (2003), for cases where it is not practical to study the alternative crops that might substitute for the crop of primary interest to estimate social and rental rates.

Table 2 presents details of how the social and private costs in the various districts were obtained.

Table 2: Computation of PAM for Farmers (Figures in brackets are costs in Ghana cedis)

Garu				
	Input	Quantity/hectare	Private price (GH ¢)	Social price (GH ¢)
Tradable	Fertilizer (kg) Seed (kg)	222.30kg 7.41kg	111.15 4.03	117.15 4.59

		Family	Hired	Combined	Combined
Factors	***Labour (person-days)*** Sowing Fertilizer application Manure application Weeding Harvesting Threshing Bagging ***Capital (GH¢)*** Bullock services	6.45(7.98) 4.12(5.41) 4.03(4.10) 9.36(12.72) 6.72(8.57) 4.54(5.24) 2.69(3.04)	6.45(9.34) 6.05(7.90) 6.49(4.72) 9.88(14.94) 4.74(6.97) 4.47(7.41) 4.12(8.23) (46.91)	17.31 13.31 8.82 27.69 15.54 12.65 11.26 46.91	29.02 22.89 23.69 43.29 25.79 20.28 15.34 46.91
Output		643.06kg		257.37	399.35
Tumu					
Tradable	Fertilizer (kg) Seed (kg)	296.40 kg 7.41kg		108.68 3.29	124.78 4.59
Factors	***Labour (person-days)*** Sowing Fertilizer application Manure application Weeding Harvesting Threshing Bagging ***Capital (GH ¢)*** Tractor services	5.41(11.21) 2.89(5.85) 4.62(4.03) 7.56(19.81) 6.47(11.63) 6.22(6.92) 1.73(4.03) -	5.51(13.68) 3.06(7.01) 2.47(4.37) 6.87(22.70) 5.66(12.20) 2.69(6.39) 1.46(6.03) (54.78)	24.90 12.87 8.39 42.51 23.84 13.31 10.05 54.78	24.58 13.39 15.96 32.46 27.29 20.06 7.16 54.78
Output		661.69 kg		264.78	410.86
Saboba					
Tradable	Fertilizer (kg Seed (kg	296.40kg 7.41kg		118.56 4.30	124.78 4.59

Factors	***Labour (person-days)*** Sowing Fertilizer application Manure application Weeding Harvesting Threshing Bagging *Capital (GH¢/ hectare) Tractor services	9.21(19.29) 2.00(4.67) 3.04(7.04) 21.81(55.55) 9.16(18.25) 4.74(9.53) 1.63(4.03)	8.47(21.19) 0.69(2.10) 2.10(3.88) 7.58(20.38) - 4.94(14.10) - (58.51)	40.48 6.77 10.92 75.93 18.25 23.64 4.03 58.51	39.79 6.05 11.56 66.15 20.62 21.79 3.68 58.51
Output		534.76 kg		213.90	332.09

Source: Field Survey, 2009

Results and Discussion

Sorghum Productivity

Productivity refers to output per unit resource use, typically land. Table 3 gives some information of the relative production and productivity of sorghum in the different locations.

Table 3: Sorghum Production and Productivity in the Three Selected Districts

District	Average hectares of sorghum cultivated	Sorghum varieties cultivated for brewery	% farmers who obtained seed from marketing companies	% farmers who applied inorganic fertilizer alone	% farmers who applied both organic manure and inorganic fertilizers	Average number of bags of inorganic fertilizers applied*	Average yields obtained (Kg/ha)
Garu-Tempane	0.81	Dorado	28.9% (of 90 farmers)	18.9	81.1	1.5/acre (0.612/ ha)	643.50
Sissala East	0.72	Kapaala	94.9% (of 98 farmers)	87.8	12.2	2.0/acre (0.816/ ha)	661.50

Saboba	0.50	Kapaala	97.0% (of 99 farmers)	89.9	10.1	2.0/acre (0.816/ ha)	535.00

***Average of only those who applied inorganic fertilizers**

Source: Field Survey, 2009

Areas cultivated by households are generally very low, averaging 0.50 hectares in the Saboba District to 0.81 hectares in the Garu-Tempane District. This means volumes required for breweries can be achieved if large numbers of farmers cultivate the required varieties of sorghum or if existing sorghum farmers increase their areas of production. The varieties currently produced for the breweries are Dorado and Kapaala. From Table 3, it is clear that the production of sorghum in Garu-Tempane District is more conventional than in the other areas in the sense that Garu-Tempane farmers use their own seeds and also use organic/inorganic manure mixtures while farmers in the Sissala East and Saboba Districts largely obtain seed from marketing companies and also use largely inorganic fertilizers. Yields from the two systems are however not significantly different as can be seen from the table. There is therefore need for more research into sorghum agronomy in the area especially with regards to the appropriate organic/inorganic fertilizer mixtures since there is growing evidence of higher productivity of organic/inorganic fertilizer mixtures (Dapaah et. al., 2005, Kpongor et. al. 2009, Quansah, 2010).

PAM Results

The results of the PAM analysis are presented in Table 4.

Table 4: Policy Analysis Matrix (PAM) for Sorghum Production

	Revenues	Costs		Profits
		Tradable inputs	Domestic factors	
Garu				
Private prices	257.37	115.18	153.49	-11.30
Social prices	399.35	121.75	227.22	50.38
Divergence	-141.98	-6.57	-73.73	-61.68
Sissala East				
Private prices	264.78	114.44	190.66	-40.32
Social prices	410.86	129.38	195.67	85.81
Divergence	-146.08	-14.94	-5.01	-126.13

Saboba				
Private prices Social prices Divergence	213.90 332.09 -118.19	122.86 129.38 -6.52	238.53 228.15 10.38	-147.49 -25.44 -122.05

Note: Average yield of sorghum: Garu = 12.87 bags/hectare (643.50kg/hectares)
Sissala East= 13.24bags/hectare (661.95kg/hectare)
Saboba= 10.69bags/hectare (534.50kg/hectare)

Source: Author's Computation

Private profits, that is observed revenues less observed costs reflecting actual market prices received or paid by farmers, is negative for all three districts. This means the rate of returns to management and land is subnormal in these farming areas. Likely reasons for the negative private profit are the high costs involved in the production system (as indicated from the cost estimates), the low yields in 2008, and the erratic nature of rains especially in the 2007 and 2008 cropping years (as stated by many key informants). However, social profitability which measures comparative advantage or efficiency in the agricultural commodity system is positive except for the Saboba District (Table 4). This implies that the production system is socially efficient in the Garu-Tempane and Sissala East Districts but inefficient in the Saboba District. It means, for the case of Saboba District for the 2008 production year, it costs less to the nation to import sorghum than produce it in that district. It must be noted that this may not be the case in other production years because the 2008 production year was characterized by floods in this farming area which led to very low yields. As indicated earlier, the district is drained by the Oti River and its tributaries and easily outflows its boundaries when there is excess precipitation thereby flooding the area. Costs of production, especially labor, are also observed to be high in this area relative to the other areas. The likely overall implication is that the Saboba District has low potential for commercial sorghum production.

The divergence in revenues which is the difference between private and social revenues and used to infer the direction of policy impact are negative in all three districts as given in Table 4. That implies that the production system is implicitly taxed or resources are being transferred away from the system. According to Pearson and associates al. (2003) most output transfers, where they occur, have been caused by distorting policies such as distortions in price policy – trade restrictions or taxes/subsidies – enacted to promote non-efficiency objectives, and disequilibrium exchange rates arising from macro-economic policies that are not in balance. In the case of sorghum in Ghana, the market price (private price) is less than the efficient price (social price) and thus causing negative transfers in the system. The degree of effects in divergence or policy transfer in general is normally described using the indicators of the PAM which are discussed in the next section.

The tradable input transfers are also negative implying that there has been an implicit subsidy or transfer of resources in favor of the agricultural system. This can be traced to a 50% subsidy which was put on fertilizer in the 2008 production year by the government to boost local production. The subsidy thus makes farmers pay less for fertilizer as compared to the real market prices.

Divergences in factor markets result from both market failures and distorting policies. The results in this study reveal that Garu-Tempane and Sissala-East Districts have negative domestic factor transfers implying an implicit subsidy or transfer of resources in favor of the agricultural system. Saboba District however indicates a positive transfer meaning that the system is implicitly taxed or resources are transferred away from the system. In estimating the factor costs, it was realized that unskilled labor in Saboba District was more costly as compared to that of Garu-Tempane and Sissala East Districts, hence, the differences in divergence in the districts. However, according to Pearson and associates al. (2003) past studies of agricultural systems in developing countries have found that significant market failures influencing factor prices are common, thus factor markets are imperfect.

Degrees of Transfers in Sorghum Production

Table 5 presents indicators which allow the impact of policy on commodity systems to be studied.

Table 5: Private and Social Indicators of the PAM for Sorghum Production

	Indicators					
District	NPCO	NPCI	EPC	PCR	DRC	SRP
Garu-Tempane	0.64	0.95	0.51	1.08	0.82	-0.15
Sissala-East	0.64	0.88	0.53	1.27	0.70	-0.31
Saboba	0.64	0.95	0.45	2.62	1.13	-0.37

Source: Author's Computation, 2009

The nominal protection coefficient (NPC) is a ratio that contrasts the private commodity price with a comparable social price. It indicates the impact of policy (and of any market failures not corrected by efficient policy) that causes a divergence between the two prices, (Monke et. al., 1989). The NPC on both outputs and tradable inputs (i.e. NPCO and NPCI respectively) are below unity in all three districts. This means that policies (such as the fertilizer subsidy and the premium prices negotiated by the farmers and marketers) are reducing the market prices of outputs and tradable inputs. The NPCO of 0.64 means the private price of sorghum is about 36% lower than its world price. On the other hand the NPCI values which are all less than one show that policies are reducing input costs making them less costly compared to their world prices. For instance, the NPCI value for Sissala-East District which is 0.88 implies that the fertilizer subsidy which is the main policy is making tradable inputs cost an average of 88% of their world prices.

The effective protection coefficient (EPC) measures the degree of policy transfer from product market policies and is the value added in private prices to value added in world prices (Seini, 2002; Monke et. al. 1989; Pearson et. al., 2003). The EPC is less than one in all the production areas. This is an indication that the sorghum system has lost almost all its protection. The EPC like the NPC however ignores the transfer effects of factor market policies and is therefore an incomplete indicator of incentives, a major disadvantage of the PAM, (ibid).

The private cost ratio (PCR) is the ratio of domestic factor costs to value added in private prices, and a domestic resource cost ratio as a proxy measure for social profits. Entrepreneurs in a system prefer to earn excess profits, and this is achieved if private factor costs are less than their value added in private prices. The PCR is greater than one in all three areas indicating negative private profits. On the other hand, the domestic resource cost (DRC) is less than one for Garu-Tempane and Sissala East Districts implying positive social profits in those areas whiles that of Saboba District is more than one, indicating negative social profits. The DRC serves as a proxy measure for social profits. Minimizing the DRC is equivalent to maximizing social profits.

Finally, the subsidy ratio to producers (SRP) is the net policy transfer as a proportion of total social revenues. It shows the proportion of revenue in world prices that would be required if a single subsidy or tax were substituted for the entire set of commodity and macroeconomic policies, (Monke et. al., 1989). From Table 5, it is obvious that on the average, prevailing agricultural policies, particularly the 50% fertilizer subsidy, do not effectively subsidize sorghum production at the current levels in any of the producing areas since all the SRP figures are negative. This is probably because many of the farmers do not have access to the subsidized fertilizer (as indicated by farmers during the field survey) due to time and distance constraints and some bureaucratic processes.

Forecast Profitability Levels of Sorghum Production

MOFA, the national body in charge of agriculture in Ghana, has estimated that the average yield of sorghum in northern Ghana is about 26 bags per hectare (or 1300 kg/hectare). Though a few farmers in the study area representing 4.67% of the farmers had up to this yield, the average yields recorded in all three districts were lower than the average yield estimated by MOFA. All things being equal, if farmers' average yield per hectare in the 2008 cropping year were 26 bags (1300 kg) per hectare as estimated by MOFA, then the PAM results would be as in Table 6.

Table 6: Forecast Policy Analysis Matrix (PAM) for Sorghum Production

	Revenues		Costs				Profits	
		Tradable inputs		Domestic factors				
	MOFA Estimates *	Efficient Farmers **	Average farmer	Efficient Farmers	Average farmer	Efficient Farmers	Average farmer	Efficient Farmers
Garu								
Private prices	520.00	635.28	115.18	127.55	153.49	191.10	251.33	316.63
Social prices	807.30	984.69	121.75	74.39	227.22	267.95	458.33	642.35
Divergence	-287.30	-349.41	-6.57	53.16	-73.73	-76.85	-207.00	-325.72
Sissala East								
Private prices	520.00	562.17	114.44	116.81	190.66	177.29	214.90	268.07
Social prices	807.30	871.37	129.38	125.28	195.67	256.36	482.25	489.73
Divergence	-287.30	-309.20	-14.94	-8.47	-5.01	-79.07	-267.35	-221.66
Saboba								
Private prices	520.00	494.00	122.86	160.32	238.53	225.63	158.61	108.05
Social prices	870.30	765.7	129.38	90.82	228.15	278.54	512.77	396.34
Divergence	-350.30	-271.70	-6.52	69.50	10.38	-52.91	-354.16	-288.29

***MOFA Estimates refer to 26 bags/ha (1 bag = 50 kg)**

****Average yields of efficient farmers:** **Garu = 31.76 bags/hectare (1588.00kg/ha)**
Sissala East= 28.11 bags/hectare (1405.50kg/ha)
Saboba= 24.7 bags/hectare (1235.00kg/ha)
(Efficient farmers are those with yields of 26 bags/ha and above)

Source: Author's Computation

Table 6 also presents results of farmers who got up to 26 bags (1300 kg) per hectare. In both cases, farmers would be competitive and thus make supernormal returns in all three producing areas Saboba District will also have a comparative advantage in sorghum production as against imports in these pegged yields. This clearly indicates that yield and price of sorghum are critical determinants of the competiveness of the crop in northern Ghana. In terms of suitability of the areas for sorghum production, the results show that Garu-Tempane District has the highest comparative advantage followed by Sissala East District.

Conclusion and Recommendations

The paper analyzed the productivity and competitiveness of sorghum production in northern Ghana using the PAM approach as a method of analysis to estimate costs and returns, and to infer competiveness.

For profitability levels at the farm gate, farmers were making losses of GH¢11.30, GH¢40.32, and GH¢147.49 per hectare at Garu-Tempane, Sissala East, and Saboba Districts respectively, implying all three areas recorded subnormal returns to land and management and therefore uncompetitive. However, social profitability was positive for both Garu-Tempane and Sissala East Districts but negative for Saboba District. While GH¢50.38 and GH¢85.81 were obtained for Garu-Tempane and Sissala East Districts respectively, a loss of GH¢25.44 was obtained for Saboba District, a clear indication that Garu-Tempane and Sissala East Districts are efficient in sorghum production and thus have a comparative advantage. The main cause of the subnormal (private) returns in all three areas was the relatively low yields and the high cost of production. As such, a PAM was calculated using MOFA's recorded average yield and it was found out that farmers would be making supernormal returns to land and management if they are able to obtain that yield (1,300kg/hectare).

Some estimated indicators of the PAM revealed that, on the average, sorghum production is not protected by policy with EPC values less than one (1) in all three districts. The NPC values indicated that private prices of outputs and tradable inputs are less than their social prices. The PCR also showed that private profits are negative. On the other hand, the DRC values revealed that social profits are positive in Garu-Tempane and Sissala Districts but not in Saboba District. Finally, the SRP were all negative meaning prevailing agricultural policies (mainly the fertilizer subsidy) did not effectively subsidize sorghum production in the 2008 cropping year.

At the current level of productivity, sorghum yields a profitable return to land and management at social prices but sub-normal returns at private prices. Thus, the nation generally has a comparative advantage in producing sorghum as compared to sorghum importation; however, farmers are averagely not competitive in production. To make sorghum production efficient and competitive, the profit levels of farmers must improve significantly and therefore must be of major concern in policy formulation. To this effect it is recommended that the cost of production and output levels of farmers be considered by the marketing companies when negotiating the premium price with farmers so that farmers can at least break even.

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