Profitability and Competitiveness of the Main Crops Grown under Rain-Fed Sector of Gadarif State, Sudan

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Authors' contributions

This work was carried out in collaboration between both authors. Authors NSEA and MMME designed the study and wrote the protocol. Author NSEA wrote the first draft of the manuscript and managed the literature searches. Author MMME supervised the data collection, supervised the work and edited the manuscript. Authors NSEA and MMME manage the statistical analysis. Both authors read and approved the final manuscript.

Original Research Article

ABSTRACT

The aim of this study was to examine the profitability and competitiveness of the main crops grown under the rain-fed sector of Gadarif state: Sorghum, millet, sesame and groundnuts. The study used both primary and secondary data. Primary data covered the three scale of semi-mechanized farms in the state (small, intermediate and large scale). Primary data on small-scale farmers were collected by means of questionnaire from 175 in Gadarif State, during 2012/2013 season. Primary data on large and intermediate-scale farmers were collected from unpublished records of the Ministry of Agriculture and Forestry, Gadarif State. Secondary data were collected from Central Bureau of Statistics and Federal Ministry of Agriculture. Policy analysis matrix was used to reach to the stated objective. Results revealed that, the four grown crops in the study area are proved to be

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financially and socially profitable despite the discouraging policies. The taxes on domestic input transfer for the four crops and output for groundnuts negatively affects the profitability, competitiveness and comparative advantages of all crops and give fragile results under shocks, except sesame which showed strong results under all conditions. Policy-wise, government should reduce taxes and provide incentives for farmers participating and adopting extension programs. It should also invest on the infrastructure to link farmers to a high value markets. Likewise, they should expand microfinance to cover all farmers.

1. INTRODUCTION

Agricultural is the backbone of the Sudanese economy contributing substantially to the Gross National Product (31.6%) [1], employing the majority of the country's workforce (50.6%) [1], and providing raw materials for other sectors. Further, this sector plays a significant role in the Sudan's foreign trade. In 2009 its contribution on none oil export revenue was 93% [2]. Moreover, it provides income, employment, food and farm energy. The main agricultural exportable products of the Sudan are: cereals mainly sorghum, oilseeds (cotton, sesame and ground nuts), gum Arabic, livestock, meat, and others.

The agricultural sector of the Sudan is divided into three farming systems: irrigated, mechanized rain-fed and traditional rain-fed [1]. The cultivated area under the three systems is approximately 17 million hectares constituting about 20% of the potential agricultural lands [3]. The irrigated sector represents 11% of the total cultivated area, and contributes more than 50% of the agricultural production volume. The rain-fed sector, confined mainly to central Sudan, is the largest in terms of land (12.18 million ha) but least in productivity. The annual rainfall barely exceeds 700 mm and is limited to four months (July-October). The average annual rainfall which varies in both frequency and quantity is estimated at 400-700 mm. The main agricultural crops produced in the rain-fed sector are: cereal (sorghum and millet) and cash crops (sesame, and groundnuts). Taking in mind the importance of agricultural sector to the food security situation and the country economy, the government undertakes different policy measures to improve this sector and the entire economy. Among these policies were: liberalization policy (1992), and agricultural revival program (2010-2014). The liberalization policy (Economic reform programs), change the agricultural sectors as well as the Sudanese economy from an economy led by government decisions or central planning (public sector), to economy guided by market forces characterized by competition, in addition, to giving a greater role for the private sector to lead the development process. Despite the importance of the semi-mechanized rain-fed subsector to the Sudanese economy, this subsector is still lagging behind in terms of its poor and declining productivity [3]. The main reasons behind that is sorghum mono-cropping, poor farmers' resources, inefficient use of resources, adoption of low level of technology, unavailability and high cost of inputs, and limited or fertilizers [3,4].

The Sudanese Government is constantly searching for ways to improve productivity and marketability of the crops grown in the rain-fed sector of the country. Thus, directed it is attention and policies to Gadarif State, the main cereal (sorghum and millet) and oil crops (sesame and groundnuts) producers. The state, which is located in the eastern part of Sudan and shared international borders with Ethiopia and Eretria, covered a total area of 71.62 thousand Km^2, and plays a great role in the country food security situation. The total cultivated rea of the state is estimated 3.1 million hectare being the largest rain-fed cultivated area of the country. The average rain-fed mechanize farms size in the state is 1000 feddan (420 ha) [3].

Information on different crops profitability (private and social) under different policy options is important in decision making at macro and micro levels. In general, such information allows the formulation of appropriate policies and helps to understand and predict short and long run impacts of policies and technologies on production. Knowledge of such information is also important for understanding the dynamics of the producers. Further it could be useful for government planning and structuring of programs and services, the distribution of which is based on production behavior and response to the changes in such options. Analysis of the governmental policies on crops profitability in the rain-fed sector of Sudan has been limited. This

necessitated conducting out this study which aimed to examine the effect of governmental policies on the profitability and competitiveness of the main crops produced under the rain-fed sector of the Gadarif state (sorghum, millet, sesame and ground nuts)

2. METHODOLOGY

This study was conducted in the rain-fed sector of Gadarif State Sudan. The study depended in both primary and secondary data. Primary data covered the three scale of the semi-mechanized farms in the state [small (less than 210 ha), intermediate (210 – 420 ha) and large scale (more than 420)], although, there is no significant difference between the three types in the cultural practices and productivity [5]. Primary data on small scale farmers were collected by means of questionnaire from 175 in Gadarif State, during 2012/2013 season. Primary data on large and intermediate-scale farmers were collected from unpublished records of the Ministry of Agriculture and Forestry, Gadarif State. Secondary data were collected from Central Bureau of Statistics and Federal Ministry of Agriculture. Data analysis depended mainly on the PAM model that was developed by [6]. This model is widely used in agricultural analysis [7-12].

A simple PAM model is as follows [6]:

Profit = Revenue - Costs

This can be rewritten in the form:

$$NSP = E(P_q)Q - e(P_t)It - (P_n)In$$

Where:

NSP= net profit.
E = exchange rate of foreign exchange.
Pq = price of the product.
Pt = price of tradable inputs.
Pn = price of non-tradable inputs (local resources).
Q = the quantity of production.
It = the amount of tradable inputs.
In = the amount of non-tradable inputs (local resources).

The study derived the following measures from the policy analysis matrix to reach to the stated objectives, these measures are: Private Profitability, Social Profitability, and Profitability Coefficient (PC).

Correction for distortions were made through replacing market prices by their shadow prices [13,14]. All inputs and outputs prices were measured by their available international price or international prices for their substitute (similar goods). Non-tradable goods, such as handling, marketing and transport…etc. were adjusted by using the conversion factors; the ratio of alternative output value at border price to the actual output value at market prices. Non-tradable goods were also measured by breaking them down into their tradable and primary factors of production.

3. RESULTS AND DISCUSSION

Results PAM analysis revealed that, the financial and economic profitability of the main crops grown in the rain-fed sector of Gadarif state (sorghum, millet, sesame and groundnuts) are positive, indicating that they are substantially profitable and have high comparative advantages (Table 2). Taking sesame in consideration this crop gained an outstanding economic (1174 SDG) and social profitability (714.30 SDG), compared with other crops, followed by millet. On the other hand, farmers continue cultivating groundnuts (negative profit) and sorghum (low private profit), because groundnut is the main cash crop for female-farmers and sorghum is a subsistence crop.

The negative value for the divergence between financial and social price for the cost of tradable inputs (such as seeds, chemicals and fertilizers) for the four crops means that government support the tradable inputs in the study area. But the positive sign of the cost of domestic input transfer, for the four crops, indicate that the government has substantially taxed these items. This particularly true if it is known that, the revival program is totally based on the free market mechanism. Accordingly the government did not support local inputs. And to encourage rain-fed agricultural sector the government long-lease the agricultural land with cheap price, but small-scale farmers did benefited from it. On the other hand, the revenue transfer for sesame, sorghum and millet are positive indicating that these crops are highly supported by the government. But, the result of groundnut (negative sign of revenue transfer) indicates that this product is not supported (taxed) by the government.

The divergence between private and social price of domestic factors are generally very small because labor cost are more or less correctly

priced at social opportunity cost without government intervention. The most important source of divergence in domestic factors price lie in the machinery and capital charges.

The high and positive value of the financial and social profitability for the four crops indicates that the applied price policies encourage efficient utilization of resources. In the same vein, the positive sign of the profitability transfer for all crops, except groundnut, means that the overall effects of the government intervention policies on each of these crops systems, which in turn affects the inputs and out prices and exchange rate, are in favour of the producers in the short-run. And the negative value of the groundnut revenue transfer indicates that producers of this crop are highly taxed [15]. The tax effect can be from the government intervention or market imperfection or both. Surely, if incentives are

given to groundnut farmers they can linked to a high value international market thus improve their private revenue. But, the negative divergence between social and private output prices for groundnut might be attributed to internal market failure. This result suggests the existence of market imperfection in output markets.

3.1 Policy Implication of the Results

PAM results showed that, the role of government intervention is still short of optimum. Despite the fact that all crops are proved to be financially and socially profitable, therefore, they should be promoted and encouraged. The situation is worse for groundnut production as farmers are taxed in both domestic-input and out-put transfer. Results of these policies are proved to discourage farmers from producing socially profitable crops like groundnuts.

Table 1. Structure of the policy analysis matrix [6]

Statement	Revenue	Costs		Profit
		Tradable input	Domestic factors	
Private	A	B	C	D
Social price	E	F	G	H
Divergences	I	J	K	L

Private profit, D = (A - B - C); Social profit, H = E - F - G; Output transfers, I = A - E; Tradable input transfers, J = B - F, Non-tradable input transfers, K = C - G; Net transfer, L = D - H = I - J - K.
Where: A: Total income; B: The cost of tradable inputs; C: The cost of resources for local prices; D: Prices for profit; E: Total income social prices (revenues without a policy); F: The cost of tradable inputs prices social; G: The cost of the social resources of local prices; H: Social profits

Table 2. PAM for the main crops grown in the rain fed sector of Gadarif State Sudan (sorghum, millet, sesame and groundnut) SDG/ton

Indicator	Revenue	Costs		Profit
		Tradable input	Domestic input	
Sorghum:				
Financial price	450.00	200.57	117.54	131.89
Economic price	318.81	233.02	70.74	15.06
Divergence	131.19	-32.44	46.80	116.83
Millet:				
Financial price	560.00	214.16	126.80	219.05
Economic price	413.19	248.79	85.55	78.85
Divergence	146.81	-34.64	41.25	140.20
Sesame:				
Financial price	1579.80	100.64	305.26	1173.91
Economic price	1073.41	116.91	242.20	714.30
Divergence	506.39	-16.28	63.05	459.61
Groundnuts:				
Financial price	462.14	82.56	285.04	94.54
Economic price	768.84	95.91	240.73	432.19
Divergence	-306.70	-13.35	44.30	-337.65

The problems facing crops production in the rain-fed sector of Gadarif state are in the details of management: output market, input markets and agronomic improvement of the crops. Farmers are complaining from inadequate finance, unavailability of inputs at right time, marketing problem, high taxes, and inadequate extension services.

3.2 Measures of Profitability, Competi-tiveness and Protection Coefficient of the Main Crops Grown in Gadarif State

Four types of measures were used in analyzing and comparing policies used in the development of the rain-fed sector of Gadarif state, these are: measures of private profitability, measures for social profitability, measures of international competitiveness and measures of protection coefficient (Table 3) The net economic profitability (H) is called the efficiency measures because both output (E) and input (F+G) are valued in price that reflects scarcity or social opportunity cost. If the value of economic profitability is positive and greater than unity it indicates that the crop produced in the area has a comparative advantage under the prevailing conditions. The net private profitability reflects that sesame was the most profitable crops grown in the study area under the available financial prices, policy measures, technology, costs and

returns of the product at season 2013. Other profitable crops in chronological order are millet sorghum and groundnuts.

Private cost (PRC) and Private cost benefit ratio (PCB) should be less than one to be both privately and socially profitable. PRC can be defined as the numbers of units of domestic resource cost spent to save unity value added. The PCB means that the costs needed to save a unit pound revenue. In ranking the crops according to their profitability sesame occupied the first position (got the least value compared with others crop) and groundnut is the last. Generally, all crops are socially and financially profitable. But when taking economic profitability in consideration groundnuts moves to the second position after sesame according to domestic resource cost ratio (DRC). Domestic resource cost for any crop is the measure of comparative advantage and means the opportunity cost of using domestic resources is lower than international value added at world prices. Accordingly for the crop to be economically profitable it is DRC should be less the one. Results revealed that all crop grown in the rain-fed sector of Gadarif state has comparative advantage. In other words, each the four crops grown in study area produces more than enough international value added to compensate for domestic factors used.

Table 3. Measures of profitability, competitiveness and protection coefficient for sorghum, millet, sesame, groundnut grown under the rain-fed sector of Gadarif state Sudan 2013

Measures/ crops	Sorghum	Millet	Sesame	Groundnuts
Measures of private profitability (profitability):				
Net private profitability (D)= A-B-C	131.89	219.05	1173.91	94.54
Private resource cost (PRC)= C/(A-B)	0.47	0.37	0.21	0.75
Private cost benefit ratio (PCB)= (B+C)/A	0.71	0.61	0.26	0.80
Measures of social profitability (comparative advantage or efficiency):				
Net economic profitability (H)= E-F-G	15.06	78.85	714.30	432.19
Domestic resource cost (DRC)= G/(E-F)	0.82	0.52	0.25	0.36
Social cost benefit ratio (SCB)= (F+G)/E	0.95	0.81	0.33	0.44
Profitability coefficient (PC)= D/H	8.76	2.78	1.64	0.22
Measures of international competitiveness:				
International value added (IVA US$)=(E-F)/exch	16.25	31.14	181.16	127.45
Coefficient of International Competitiveness (CIC)= G/IVA	4.35	2.75	1.34	1.89
Measures of protection incentives:				
Nominal protection coefficient for tradable outputs (NPCo)= A/E	1.41	1.36	1.47	0.60
Nominal protection coefficient for tradable inputs (NPCi)= B/F	0.86	0.86	0.86	0.86
Effective protection coefficient (EPC)= (A-B)/(E-F)	2.91	2.10	1.55	0.56

On the other hand, the concerned of the profitability coefficient (PC) is on the positive numbers only. That is, if this ratio is greater than one, farmers are subsidized and if it is less than one, farmers are taxed. Our findings confirm the earlier results that all crops are subsidized except groundnut which is taxed.

In assessing the international competitiveness of the four crops, two measures were used these are international value added and coefficient of international competitiveness. Results of these two measures indicate that the four crops are internationally competitive. The amazing thing is that, despite the high taxes imposed on groundnut this crop occupied the second position, after sesame, in terms of it is international competitiveness. The coefficient of international competitiveness revealed that sesame, groundnuts, millet sorghum used 1.34, 1.89, 2.75 and 4.35 SDG of the domestic resources, respectively, to gain one US$. (US$= 6.189SDG).

Measures of protection incentives were also studied. Results of the ratio of the effective protection coefficient of less than one indicate a tax on producers and of more than one indicate a subsidy for the crop. Results of this measure prove the earlier findings that all crops are somehow supported by the government except ground. Nevertheless, results of the Nominal protection coefficient for tradable outputs for all crops, except groundnuts, are greater than one indicating that the producers of these crops are subsidized. Likewise, results of the nominal protection coefficient for tradable inputs for all crops, which equals to 0.86 each, that is less than one, reflects that the production inputs for all crops subsidized.

3.3 Sensitivity Analysis

PAM results are further subjected to three scenarios to assess the reliability and enhance accuracy and precision. These scenarios are: decrease in FOB price by 10%, decrease in farm gate price by 20% and increase in shadow price by 5%. Results of the sensitivity analysis revealed that sesame is not affected under all scenarios. This crop is proved to be of high private, social and international competitiveness. Other crops are sensitive to these scenario by various degree and shows fragile situation.

4. CONCLUSION

Results revealed that government intervention is still short of optimum, despite the fact that, all studied crop are proved to be socially and financially profitable. Farmers producing sorghum, sesame and millet are taxed in domestic-input. The situation is worse for the socially profitable groundnut-crop which is taxed in both domestic-input and out-put. These policy discourages female-farmers, the main producers of groundnuts in the state, from continue cultivating this crop. Sensitivity analysis proved that sesame is a competitive crop and have a substantial profitability and comparative advantages. Other crops, sorghum millet and groundnuts revealed fragile profitability and comparatives advantages under the current policy situations. Accordingly, in order to improve the profitability and competitiveness of the main crop grown in the rain-fed sector of Gadarif State, the government should reduce taxes and provide incentives for farmers, particularly groundnut producers, invest on the infrastructure, these subsidies should be linked with farmers' participation on extension programs and adoption of new technology.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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