

Economics of Sorghum Production under Traditional Farming System in Nyala Governate of South Darfur State, Sudan

Thabit Ahmed Hassan

Department of Agricultural Economics, Faculty of Agriculture University of Zalingei, Sudan
thabitkiter@yahoo.com

ABSTRACT

This study on the economics of sorghum production under traditional farming system was conducted in Nyala Governate of South Darfur State, Sudan. It was focused on socio-economic characteristics of the farmers that affect sorghum production. Descriptive statistics analysis was applied to primary data collected from two stages stratified random sample of 192 sorghum producers using structural questionnaire. The results shows 47.54% of farm household members are illiterate, 43.75 percent of the respondents have more than one wife, average household size is of 7 members and the range is about one to more than ten members. The results of regression coefficient of own plow (D2) and operational area (OP) were significant at 1% level, while total labour (family and hired) and farm household age insignificants. To give attention to adult education and training more priority especially females who mostly shoulder the wide responsibilities of field activities. To develop the traditional rainfed production with especial attention given on the valley's deposits and clay soils for agricultural production.

Keywords: *Darfur, Sorghum, regression, significant, semi-arid, traditional.*

1. INTRODUCTION

Sorghum is the fourth most important world cereals crop following wheat, rice, and maize. It is a staple food in the drier part of Africa, China and India, [10,13]. Sorghum is a cereal grain crop mostly grown in Africa, Asia and Central America, primarily to ease food insecurity. It is the world's fifth largest grain crop and Africa's second most important in terms of tonnage. Sorghum is mostly grown in semi-arid or sub-tropical regions of the world due to its resistance to harsh droughts and long dry spells during the rainy season are a common feature, [5] It is reported that the effect of drought is more pronounced in the Semi-Arid Tropics (SAT), where rainfall is generally low, erratic and poorly distributed, [13] Sorghum has a short duration (typically three to four months from planting to harvest), and can be grown in a wide range of soil types.

Africa accounts only for a quarter of world's sorghum production. Nigeria and Sudan contribute nearly half of the sorghum production in Africa, [13]. Sudan is one of the most important countries producing sorghum in the world. It ranks the fifth after China, India, USA and Nigeria in sorghum production, [9], but it is number one in per capita area and grain consumption for human beings.

Sudan shares in total sorghum production amounted to 6.51% and 19.6% of the world and Africa production respectively in 2009/2010 season. Sorghum is produced in the three sub-sectors in the Sudan, namely; the irrigated, mechanized and traditional rainfed sub-sectors. The traditional rainfed sub-sector is mainly found in Kordofan, Darfur plus a large area in the Central States. The contribution of this sub-sector to the total sorghum output is estimated at only 29.91 percent (about 541 thousand metric tons) from an area of about 1.353 million feddan in 2011/12. The low share of this sub-sector is due to the production of sorghum mainly for subsistence.

Differences in yield of sorghum are very significant in this sub-sector depending on rainfall, soil type and the farmer efforts. Yield of the traditional sub-sector fluctuated between 0.1 to 0.2 tons per feddan during the period 2009/2010 –2011/12, with an average/fed. This low yield is mainly due to continuous cropping of land, little or no services and subsistence mode of production. Conventional farming practices also continue to exacerbate these declines in yields. Soils are being exhausted as a result of mono-cropping, and suffering from compaction due to the use of wide level discs for land preparation at valleys banks. Nevertheless this sector is neglected and suffers from extremely low yields [9]

Sorghum is grown in Darfur as the second food staple crop after millet. It is cultivated mainly on clay soils and on the banks of valleys. Darfur share in the total sorghum production in the Sudan was about 10.94 percent during 2010/2011-2011/2012 period where, this average share increased to about 13.46 percent (281 thousand metric tons) in 2011/2012, due to favorable conditions in this season Table (1-1).

Table (1-2) shows that, the area allocated to sorghum production in Darfur State increased from 431 thousand feddan in 2009/2010 to 674 thousand feddan in 2010/2011. Due to favorable weather conditions, the average area devoted to sorghum was about 536 thousand feddan during 2011/2012 and production was about 281 thousand metric tons on the average.

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Table 1.1: Percentage Share of Darfur to the Total Sorghum Production of Sudan 2009/10 – 2011/12 (000mt)

Season	Sudan	Darfur	%
2009/10	1980	224	11.31
2010/11	4606	504	10.94
2011/12	2088	281	13.46

Source: Calculated from Data Displayed in Quasi Crop and Food Supply Assessment Mission to Sudan, 2012.

This reduction as illustrated by [9,10] was due to: -

- Deterioration of soil fertility partially due to mono-cropping of sorghum, this might have been the result of the present land tenure system
- Poor husbandry practices and poor quality seeds,
- Lack of extension services,
- More attention has been given to horizontal expansion rather than investing on practices that would increase production per unit area.
- Scarcity of labour which had resulted in delay of cultural practices.

Table 1.2: Area, Production and Yield of Sorghum in Darfur 1990/91—1997/98

Season	Area (000fed.)	Production (000mt)	Yield (Kg/fed)
2009/10	431	224	714
2010/11	674	504	246
2011/12	536	281	224

Source: Calculated from Data Displayed in Quasi Crop and Food Supply Assessment Mission to Sudan, 2012

Objective of this study is: to study the socio-economic characteristics that affect sorghum production.

2. METHODOLOGY

2.1 Sample Technique

The agricultural population in Nyala Governate can be regarded as homogeneous with respect to farming

techniques, pattern of cropping and farming is labour intensive. Farm sizes in the area are generally small ranging on the average between 4.22 to 18.17 feddan.

The sample was two stages stratified random sample representing the five localities of Nyalagovernate. First, five villages were selected at random from Shataya and Belial from each. Of the others, Kass, Abu Ajura and Yassin, six villages were also selected at random. This was done in a way that each village should be located at a direction different from the others and to represent the whole geographical area of the Governate. In the second stage, from each village six to seven respondents were selected randomly 192 farm households from the list of Sugar Ration of farm households in the village, which represents 3 per cent of the total farm population in the selected villages Table (2- 1).

The data were tabulated and fed to the computer-using statistical packages for social science (SPSS) for simple statistic and econometric analysis.

2.2 Data Collection

Cross-sectional data for this study had been collected through a primary field survey. Farmers were directly interviewed to obtain primary information. The survey was in the form, of a predesigned questionnaire and direct interview. The data collected included information on land, labour, assets and livestock ownership, in addition to the different agricultural operations, the physical output, the farm gate prices of the main products and socio-economic characteristics of farm households..etc. The secondary data were collected from relevant sources, includes time series data on area, production and yields for sorghum in Sudan and particularly of Darfur. The survey was carried out during, March and April of the year 2014. This period coincided with the end of the harvesting season. The respondents at this time were expected to recall all the relevant information thoroughly.

Table 2.1: Number of Respondents Relative to the total Farming Households (HH)

Locality	Total Number of Villages	No. of selected Villages	No. of farm HH. In selected village	Respondents	% of the total
Kass	37	6	1480	40	20.8
Shataya	22	5	1367	37	19.3
Abu Ajura	32	6	1353	38	19.8
Belial	23	5	1320	38	19.8
Yassin	31	6	1441	39	20.3
Total	145	28	6961	192	100

Source: field survey 2014

2.3 Models Specification

Depending on the techniques of the model specification and the priori knowledge of the traditional agricultural production in Darfur, a modeling output for sorghum were specifically as follow:

$$Y = f(TL, FHS, FI, FHHA, OA, FD, D_2)$$

Symbolic names of variables and definitions are presented in Table (5)

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Table 2.2: Definitions of Variables

Symbols	Definitions
Y	Output of sorghum in sacks
FI	Farm Income in Sudanese (SDG)
TL	Total labour in man-day
FHS	Farm household size
FHHA	Farm household head age in years
OA	Operational area in feddan
FD	Farm distance in kilometers
D ₁	Dummy variable representing weather conditions
D ₂	Dummy variable representing ownership of plough
MD	Market distance in kilometers

All variables were in log form except the two dummy variables which had to be in linear forms, because they were recorded as qualitative variable and their observations took many zero numbers.

$$Y = \log a + b_1 \log FI + b_2 \log TL + b_3 \log FHS + b_4 \log FHHA + b_5 \log OA + b_6 \log FD + b_7 D_1 + b_8 D_2 + b_9 \log MD + u$$

However, the logs of zero were not defined of course and for this reasons the dummy variables were used in linear form. As the model is in log form the coefficients were to be the elasticity's of output except the dummy variables, (D₁ and D₂) coefficients. The elasticity's of the dummy variables from the linear forms can be calculated as

$$dY/dX * X/Y = b * X/Y \text{ where}$$

b = coefficient X and Y are means of X and Y

3. RESULTS AND DISCUSSION

3.1 Land Tenure

Table 3.2: Distribution of the Respondents According to Their Farm Size (fed)

Farm size	No. of Sample	% of Total	No. of Farms own	Av. Farm/holding	Overall Av. size of holding	Total of Feds.	% of Total
Less 5	82	42.71	154	1.88	1.91	294.45	17.22
6-10	55	28.65	93	1.7	4.5	418.75	24.5
11-15	25	13.02	39	1.56	9.33	363.87	21.29
16-20	16	8.33	22	1.38	10.93	241.33	14.12
21-25	6	3.13	9	1.5	15.56	140.04	8.19
26-30	3	1.56	3	1	19	57	3.33
0More30	5	2.6	10	2	19.4	194	11.35
Total	192	100	330	1.72	8.9	1709.44	100

Source: Field Survey 2014.

We found that, 28.13 percent of sample population in the study area has rented land, while the percentage of respondents who owned and/or inherited land were about 63.02 percent, Table (3.1). This high ratio is attributed to the fragmentation of valuable property could be a serious problem in the future in traditional cultivated system whereas the rest 8.85% had gift from their relatives. Land is more strictly inherited from the father to sons, where it is often divided among several sons. Others confirmed that the passing of land down from generation to generation tends to follow the Islamic Law.

Table 3.1: Percentage and Number of Respondents by Type of Land Ownership

Land ownership	No. Of Respondents	% Of the Total
Rented	54	28.13
Owned	70	36.46
Inherited	51	26.56
Gift	17	8.85
Total	192	100

Source: Field Survey 2014.

Many studies mentioned that, the amount of land for each production unit utilized depends on three major factors: -

- a. The number of workers available, b) the type of technology used, and c) availability of water for domestic use, [6; 7; 12,4] However, the variation of farm size among farm households is remarkable. The analysis of the survey data in Table (3.2) revealed that, about 42 percent of respondents had cultivated an average farm size of less than five feddan which is less than the overall average of farm size of the study area (8.9 feds.). This indicated that farming is almost at subsistence level like that of African small holders as mentioned by [1], who advocated that, agricultural production in Africa has virtually been dominated by small-scale farmers.

3.2 Socio – economic characteristics of the farm Household members:

This survey showed that, the age group of 16 to 59 constitutes a high proportion of the population Table (3.3). The data also showed that, the number of resident females exceeded males by about four percent. This is because youth at this age usually migrate to large cities in the State; mechanized farm schemes and irrigated schemes in the other parts of the country and the Culf countries.

Data furnished in Table (3- 4) revealed that 47.54 percent of farm household members are illiterate. This percentage is one of the factors militating against agricultural development in the study area. This result is similar to that found by [8,11, 5,2] in tradition farming systems.

The average household size is of seven members and the range is about one to more than ten members (3-4). This high average of household members may reflect a traditional attitude towards having large families, which is considered as symbol of a farmer's wealth status and social prestige within the communities. In general a large household is not without economic grounds as wives and children are productive human resources contributing to the household income.

This traditional attitude towards having larger household size can best be explained by the marital status, where figures furnished in Table (3-4) illustrate that, about 43.75 percent of the respondents have more than one wife. As was noted that children begin working regularly with their parents by the time they are eight to ten years old

Table 3.3: Distribution of Household Population in the Study Area According to Age Group and Gender

Age group	Male	%	Female	%	Total	%of total
Less- 15	390	55	375	51	765(1.45)	53.01
16 – 59	305	43	340	47	645(0.76)	44.71
More-60	19	2	14	2	33(0.54)	2.29
Total	714	100	729	100	1443	100

Source: - Field Survey 2014.

Data in parentheses are Standard Deviations

Table 3.4: Socio – economic characteristics of the farm Household members

Variable	Frequency	Percentage
Educational level		
Illiterate	686 (2.50)	47.54
Khalwa*	226 (1.43)	15.66
Primary	465 (2.29)	32.22
Secondary	59 (0.52)	4.09
Higher Education	7 (0.37)	0.49
Total	1443	100
Household Size		
1-5	70	0.36
6 – 10	86	0.45
>11	36	0.19
Total	192	100
Marital Status		
1	108	56.25
2	71	36.98
3	11	5.73
4	2	1.04
Total	192	100

Source: - Field Survey 2014

Data in parentheses are Standard Deviations

* Khalwa: education, which is the learning of the “Qura'n” the Muslim's holy book for which literacy is a prerequisite.

4. ESTIMATEDS AND RESULT OF SORGHUMPRODUCTION FUNCTION

Most of the coefficients of the estimates in Table (4-1) were significant at different levels of significance. They have the right anticipated signs according to economic theory and a priori knowledge of the researcher regarding the traditional cultivation system on sandy and alluvial soils in Darfur. The estimates, (farm household head age, total labour and farm distance) are not significant at any level. They are included in the model for their importance. The F-value as an overall measure of significance of the model was 58.5 supporting the hypothesis that at least one of the coefficients is not different from zero and could not be rejected at the 1 % level of significance compared to the tabulated F-value of 2.64 at 99 % level of significance with 7 and 184 degrees of freedom.

The coefficient of multiple determinations, R^2 , was 0.69, which implied that the explanatory variables have good fitness for the underlying data for sorghum output.

The student t-values have indicated that some of the variables are not significant at any level of significance. However, these variables were included in the model because they have expected signs and because researcher depending on the priori knowledge of the rainfed traditional agricultural production in Darfur, believes that they were important and deserve to be incorporated.

The standard errors of estimates presented in Table (4-1) are generally very low implying high

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precision of the estimates. Farm household head age variable coefficients are not significantly different from zero. turned to have the smallest standard error of estimate i.e. (0.000027). However, it is evident that some of the

Table 4.1: Coefficients of Sorghum Output Production Function in Log form

Variable	Coefficients	Standard Errors	t-values
Constant	- 0.51733***	0.281905	- 1.835
Farm household Head age (FHHA)	0.000035	0.000027	1.30
Household size (HS)	0.15486****	0.100838	1.54
Total Labour (TL)	-0.07064	0.065562	-1.08
Farm income (FI)	0.166007**	0.083944	1.98
Farm distance (FD)	0.009411	0.056134	0.168
Own of plow (D ₂)	0.192189*	0.048815	3.94
Operational Area (OA)	1.000592*	0.053652	18.65
R ² =	0.69	F-ratio =	58.5
N =	192	=	184Df
	* significant at 1 per cent level		
	** significant at 5 per cent level		
	*** significant at 10 per cent level		
	**** significant at 20 per cent level		

5. CONCLUSION

Semi-arid tropics and sub-tropics stand out as the only major regions of the world, where cereal production have the dominant role. The importance of sorghum as food grains is reflected in terms of its high percentage share of area cultivated and production to the global cereals production. Africa is the native of millet and sorghum, but it had become the second producer of sorghum after Asia and America.

The Sudan is one of the most important countries producing sorghum in Africa. It produced in irrigated, mechanized and traditional rainfed sub-sectors. Darfur shared in the national sorghum production by about 13.46% for sorghum in 2011/2012 season.

The coefficients of the estimates in Table (4-1) were significant at different levels of significance. They have the right anticipated signs according to economic theory and a priori knowledge of the researcher regarding the traditional cultivation system on sandy and alluvial soils in Darfur.

The study recommended that to give adult education and training more priority especially females who mostly shoulder the wide responsibilities of field activities and that will help them to adopt innovations and increase their productivity. To develop the traditional rainfed production with especial attention given on the valley's deposits and clay soils which are about 20% of the total arable land of the State.

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