Original Research Article

Estimation Technical Efficiency and Socioeconomic Characteristics Affect that Technical Efficiency of Crop production in the Gezira scheme, Sudan

Babiker O. Mahgoub, Omima A. Mirghani, Sara A.E. Ali

Department of Agricultural Economics, Faculty of Agriculture and Natural Resources,
University of Bakht Al Ruda, EL- Dueim, Sudan

Corresponding Author: Babiker O. Mahgoub

ABSTRACT

The primary aims of this study were estimation of technical efficiency for farmers in producing crops and determine the socioeconomic characteristics of farmers' that influence the level of technical efficiency for crop production in the Gezira scheme. Both primary and secondary data were used for the study purposes. Stochastic frontier production function was estimated using a sample of 150 farmers were collected during season 2011/2012 in the Gezira Scheme. The results showed that the mean technical efficiency of cotton, sorghum, groundnut, and wheat productions are 63%, 75%, 65%, and 90% respectively, this implying that scope to increase its crops yield through the better use of the farmers available resources are exist. Also the results revealed that socioeconomic characteristics of farmers' for affect on technical efficiency in general trend for production.

Keywords: Efficiency, crop production, socioeconomic characteristics, Gezira scheme, Sudan.

INTRODUCTION

The personal characteristics of farmers, such as the origin, the goals and the value of farmers have been an essential element in determining the resource structure of agriculture. [1] Socioeconomic characteristics of tenants are expected to have a great effect on the production process in the study area as well as their overall technical efficiency in production. They are expected to have direct and indirect effects on the farmers' performance and output Factors such as ages, family status, and education have great relevance to the pattern of agriculture and how farmers response to change. A Farmers age is one of his demographic characteristic which affects his decision and his attitude toward accepting new ideas. [2] Education level is an important factor that influences the economic situation of the different human groups. The level of farmer education has important impact on the agricultural production, literacy influenced the performance of the cultural practices in the field and educated farmers are more willing to adopt innovation which is thought to be risky then less educated farmers. [3] Practicing cultural operations of crops is not an easy job, because crops activities require regular practices, these practices cannot be accomplished properly by one person, so allocating these practices among family members lead to the fact that each practice will be accomplished properly particularly if the size of household is large. [4] The married tenants expect to have children staying with them, thus implying that these farmers could have access to family labour. The more the number of wives, expected to be the larger the family size which may provide more family labour in production than other households with different marital status. The Gezira scheme is the area that

extends from latitude 13º N to latitude 15º N between the Blue and White Niles. It covers a net cultivable area about 2.1 million feddans. Gezira scheme consists of two main parts: Gezira main with an area of 1.1 million feddan and Managil extension of 1.0 million feddan. The main crops grown in Gezira Scheme are cotton, sorghum, wheat, groundnuts, vegetables, fruits, and Fodder. [5] After the Gezira Scheme Act for the year 2005, The Act states the right of farmers' participation in decision making with regard to agricultural activities, This Act of 2005, to influence for rotation in scheme and deterioration area under crops cultivated and lead to low yield in recent years. May be problems behind crops productivity deterioration in Gezira scheme these include such as tenants' socioeconomic characteristics. The main aims of this paper was estimation of technical efficiency for farmers in producing crops and determine the socioeconomic characteristics of farmers' that influence the level of technical efficiency for crop production in the Gezira scheme.

METHODOLOGY
Data Collection
Both primary and secondary data were used for the study purposes. Primary data were collected by using structural questionnaire using stratified random sampling techniques through direct personal interviewing, where a sample of 150 tenants from (north, central, and hush) groups was collected during season 2011/2012. Secondary data collected from different relevant sources which include Planning and Socio-economic Research Administration (PSERA) of the Gezira schemes, Central Bank of Sudan, in addition to different documents, books, internet and journals.

Method of Data Analysis
Stochastic frontier production functions:
Technical efficiency is just one component of overall economic efficiency. Technical efficiency is defined as the ability to produce a given level of output with a least amount quantity of inputs under certain technology. Technical efficiency which reflects the ability of a firm to obtain the maximal output from a given set inputs. [6] Early studies focused primarily on technical efficiency using a deterministic production function with parameters computed using mathematical programming techniques. However, with insufficient characteristics of the assumed error term, this approach has an inherent limitation on the statistical inference on the parameters and resulting efficiency estimates. Aigner, Lovell, Meeusen and Battese independently developed the stochastic frontier production function to overcome this deficiency. [7,8]

Model specification:
The stochastic frontier production function model for estimating farm level technical efficiency is specified as:

$$lnYi = f(X_i : \beta) + \varepsilon_i \quad (1)$$

Where
i= 1,2,……..n
$\ln Y_i$ is the logarithm of output, X_i denotes the actual input vector, β is vector of production function and ε is the error term that is composed of two elements, that is:

$$\varepsilon_i = V_i - U_i \quad (2)$$

Where v_i is the symmetric disturbances assumed to be identically, independently and normally distributed as N $(0, \sigma^2 v)$ given the stochastic structure of the frontier. The second component u_i is a one-sided error term that is independent of v_i and is normally distributed as $(0, \sigma^2 u)$, allowing the actual production to fall below the frontier but without attributing all short falls in output from the frontier as inefficiency

Model Building
The model included the tenant's factors influencing the farmer technical efficiency. Stochastic Production Frontier Model of the Cobb-Douglas form was used to find out the tenants' technical efficiency for crop production in Gezira scheme.

$$lnyi = \beta0 + \sum_{j=1}^{4} \beta j \, lnXij + Vi - Ui \quad (\mathbf{3})$$

Where:

ln = the natural logarithm ,yi = yield of (cotton, sorghum, groundnut, wheat) (kantar /sack / faddan); X_{ij} they represent the socio-economic characteristics of farmers (age group, education level, family size and marital status) where entered of each category a separate group in analysis ; B0 and βj are unknown parameters to be estimated for the variables, respectively. vi represent the statistical error and the other factors which are beyond the tenants control such as weather, topography and other factors which are not included and may be either positive, negative or zero. ui is non negative random variable. The parameters of the stochastic frontier production function model are estimated by the method of maximum likelihood, using the computer program, FRONTIER Version 4.1.

RESULTS AND DISCUSSION

The Crops Technical Efficiency Analysis:
Stochastic Frontier version 4.1 program [6] was used to estimate the level of technical efficiency for crops. As shown in Table (I), the mean technical efficiencies of cotton, sorghum, groundnut, and wheat production are 63%, 75%, 65%, and 90% , with a minimum of 25%, 27%, 40%, and 54% and maximum of 99%, 94%, 97, and 90% respectively in the crops models in the Gezira scheme. This means that on averages, the tenants in the scheme produced 63%, 75%, 65%, and 90% of cotton, sorghum, groundnut, and wheat respectively, output that attainable by best practice, given their current level of production input and technology used. This implies that the respondents can increase their cotton, sorghum, groundnut, and wheat output by 37%, 25%, 35% and 10% respectively, from a given mix of production inputs if the tenants are technically efficient.

Socioeconomic characteristics of farmers that affect the technical efficiency for production

1. Age: Farmer's age influence his attitude toward accepting new ideas. [2] As shown in table (II) and fig.(I), in general trend, the efficiency of sorghum, wheat and groundnut trend to decreased by 0.014, 0.035, and 0.02 units respectively when age of tenant increased, while for cotton efficiency increased by 0.029. As seen from table (2), an interviewed tenant get older, and their farm production efficiency decreased. This may be young tenants are more active than old ones.

2. Educational level: Education in general can be defined as accumulation of knowledge and experience to prepare an individual for live. [2] In developing countries, where technological change is radically altering life style, education is necessary for survival; it helps people to understand and benefit from change and obtain their economic rights. [9] As depicted in table (III) and fig. (II), in general trend, the efficiency of cotton, sorghum, wheat and groundnut trend to increased by 0.01, 0.015, 0.02 and 0.005 units respectively when shifted from one level of education to another. We conclude that education has positive on crops production in Gezira scheme, this result may be explained by the fact that tenant who have education were dealing with extension services hence adopted new innovations which raised production efficiency.

3. Family size: Family can be defined as all members living within a household having a blood relationship and who are supported by an income known as the family income. [2] Beside, that family plays a vital role in the agricultural economic and development. The average tenant family size between the studied tenants was estimated to be 8 persons per household. Family size (6-10) represents the highest percentage (44%). As depicted in table (IV) and fig. (III), in general trend, the efficiency of cotton, sorghum, wheat and groundnut trend to increased by 0.155, 0.095, 0.005 and 0.02 units respectively when family size increased. The result indicates that increase in family size, increase the number of people who work in the farm. We conclude that family size has positive on crops production in the Gezira scheme, this result

explained by the fact crop production is somewhat depending on family labour beside hired labours.

4. Marital status: Table (V) and fig. (IV) Shows that the majority of sample respondents (87.3%) are married and (10%) single, and as depicted in general trend, the efficiency of cotton, wheat and groundnut trend to decreased by 0.023, 0.022, and 0.026 units respectively when shifted from one level of married status to other, while for sorghum, efficiency increased by 0.022 unit. We conclude that Married Status has negative effect on crop production in Gezira scheme, this result explained by the fact that tenant who had married pay more attention for farming than other group.

Table I: Summary Statistics of Efficiency Estimate from the Stochastic Frontier Model of cotton, sorghum, groundnut and wheat, in the Gezira scheme season 2011/2012.

Statistic	Efficiency score			
	Cotton	Sorghum	Groundnut	Wheat
Mean	0.63	0.75	0.65	0.90
Minimum	0.25	0.27	0.40	0.54
Maximum	0.99	0.94	0.97	0.98

Source: Own estimation

Table II: Distribution of Gezira scheme's tenants efficiency according to age

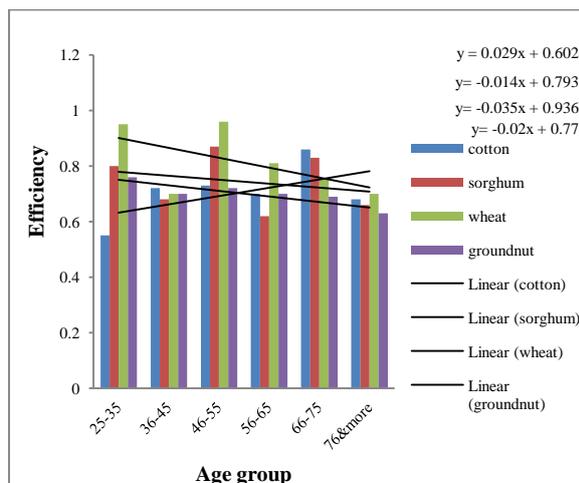| Age	%	Crop Efficiency			
		Cotton	Sorghum	Wheat	Groundnut
25-35	12.7	0.55	0.80	0.95	0.76
36-45	28.7	0.72	0.68	0.70	0.70
46-55	22.7	0.73	0.87	0.96	0.72
56-65	24.7	0.70	0.62	0.81	0.70
66-75	8	0.86	0.83	0.75	0.69
76&more	3.2	0.68	0.66	0.70	0.63

Source: Field survey, season 2011/12.

Figure I: Distribution of Gezira scheme's tenants efficiency according to age

Table III: Distribution of Gezira scheme's tenants efficiency according to education level

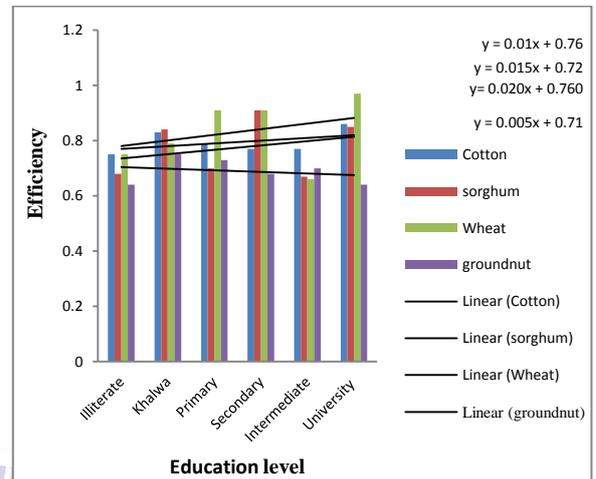| Education Level	%	Crop Efficiency			
		Cotton	Sorghum	Wheat	Groundnut
Illiterate	2	0.75	0.68	0.75	0.64
Khalwa	10	0.83	0.84	0.79	0.75
Primary	18.7	0.79	0.70	0.91	0.73
Secondary	22.7	0.77	0.91	0.91	0.68
Intermediate	34	0.77	0.67	0.66	0.70
University	12.6	0.86	0.85	0.97	0.64

Source: Field survey, season 2011/12.

Figure II: Distribution of Gezira scheme's tenants efficiency according to education level

Table IV III: Distribution of Gezira scheme's tenants efficiency according to family size

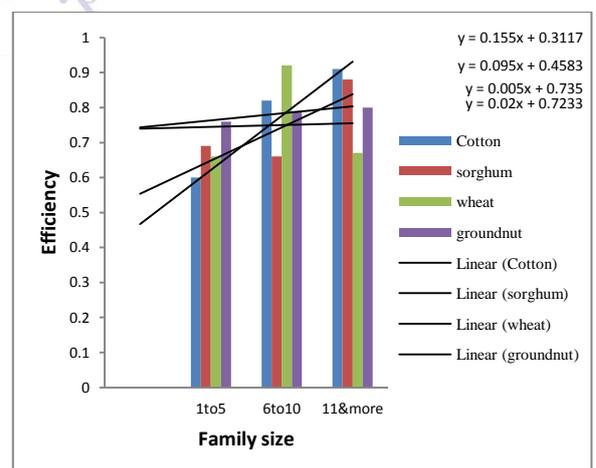| Family Size	%	Crop Efficiency			
		Cotton	Sorghum	Wheat	Groundnut
1-5	42	0.60	0.69	0.66	0.76
6-10	44	0.82	0.66	0.92	0.79
11&more	14	0.91	0.88	0.67	0.80

Source: Field survey, season 2011/12.

Figure III: Distribution of Gezira scheme's tenants efficiency according to family size

Table V: Distribution of Gezira scheme's tenants efficiency according to marital status

Marital Status	%	Crop Efficiency			
		Cotton	Sorghum	Wheat	Groundnut
Married	87.3	0.80	0.65	0.83	0.79
Single	10	0.72	0.69	0.70	0.71
Divorced	0.7	0.70	0.70	0.72	0.72
Widower	2	0.73	0.72	0.75	0.70

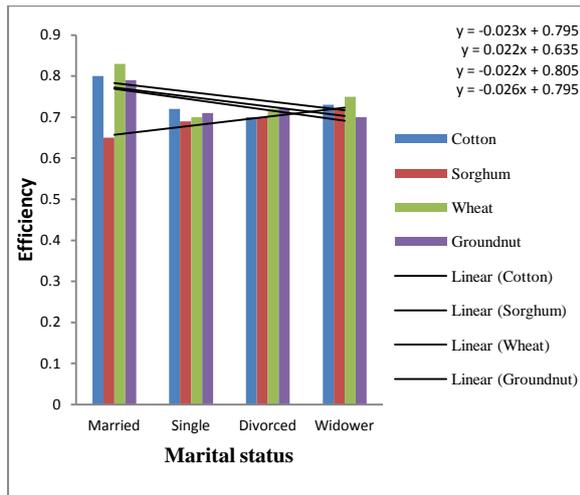Source: Field survey, season 2011/12.

Figure IV: Distribution of Gezira scheme′s tenants efficiency according to marital status

CONCUSIONS

The study concluded that, the mean technical efficiencies of farmers in the Gezira scheme more than 60%, also study concluded that farmers' socioeconomic characteristics were affected of technical efficiency of farmers in crops production, and concluded that farmers' of age group activity, good level of education, large family size, and married farmers are more technical efficiency in the Gezira scheme.

REFERENCES

1. Heady, E.O and T.Canler (1973). Linear Programming Methods. The Iowa University Press, Ames, Iowa, U.S.A.
2. Siddig, R. A. (1999). The Economic of Crop Production Under The Different Land Tenure Systems in Merowe Province, M.Sc Thesis, Department of Rural Economy, Faculty of Agriculture, University of Khartoum, Sudan.
3. Mohamed, A.S. (1996). Economics of crop production in Dongola Province. M.Sc. Thesis. Faculty of Agriculture, University of Khartoum, Sudan.
4. Elzaki, R.M. (2005). The feasibility of Integration of Livestock production in Integrated agriculture in Sudan (case study: The Gezira Scheme). Ph.D. Thesis. Faculty of Agriculture, University of Khartoum, Sudan.
5. Ahmed, A.E. (2004). Economic Analysis of Irrigated Cotton Production Constraints in Sudan: Case study Gezira scheme. Ph.D. Thesis, University of Giessen, Germany.
6. Coelli.Tim.,1998. An introduction to efficiency and productivity analysis. Kluwer Academi publishers,Boston, London.
7. Aigner, D. C. A. K. Lovell, and P. Schmidt, "Formulation and estimation of stochastic frontier production models". Journal of Econometrics; 6:21–37, 1977.
8. Meeusen, W. and J. van den Broeck, "Efficiency estimates from Cobb-Douglas production function with composed error". International Economic Review; 18:435– 444, 1977
9. World Bank (1980): In El nour S.A. An Economic Evaluation of crop Combination in Rahed Scheme, M.Sc Thesis, Department of Rural Economy, Faculty of Agriculture, University of Khartoum, Sudan.

******