Vol. 9. No. 1. 2022

Contents available at: http://www.crdeepjournal.org
DOI: 10.13140/RG.2.2.14477.82409

Global Journal of Current Research (ISSN: 2320-2920) CIF: 3.269
A Quarterly Peer Reviewed Journal

Full Length Research Paper

Estimating the Technical Efficiency of Broad Bean Production in the Old Lands of Egypt

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ARTICLE INFORMATION

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Article history:
Received: 26-02-022
Revised: 02-03-2022
Accepted: 05-03-2022
Published: 07-03-2022

Key words:
Broad bean; Technical efficiency; Old land; Production

ABSTRACT

Broad bean is one of the most important leguminous crops in Egypt. It is a crop grown in the winter season. The research mainly aimed to study the changes that occurred in the most important production and consumption indicators of the broad bean crop during the period (2006-2020). The research relied on the data envelope analysis (DEA) method in estimating efficiency. The research found a set of results, the most important of which are the following: (1) Both the area and production of broad beans took a general decreasing trend during the study period with an annual rate of decrease of about 7.4% and 7.2% for each of them, respectively. (2) the feddan productivity was characterized by relative stability, with an average of about 8.8 ard./fed. (3) The area planted with broad bean in the old lands decreased during the study period, and thus its relative importance decreased from about 70% of the total area planted with broad bean at the beginning of the period to about 37.2% at the end of the period. (4) The average efficiency value of the Egyptian bean-producing governorates was about 0.93, meaning that the productivity of an feddan could be increased by about 7% by using the same amount of inputs used in the production of broad bean. (5) achieving technical efficiency is reflected in reducing the production costs per feddan by the equivalent of 472 pounds, and thus increasing the net return by the same amount. (6) At the level of Egyptian agriculture, achieving technical efficiency achieves savings in the lands of horizontal expansion with an area estimated at about 2384 feddans, and savings in the amount of irrigation water amounting to about 4.02 million cubic meters. (7) The study recommends expanding the cultivation of the broad bean crop in new and newly reclaimed lands, with more research efforts being made to devise varieties resistant to crop pests and with high productivity to improve crop production and achieve an acceptable level of self-sufficiency.

Introduction

The broad bean crop is one of the most important leguminous crops in Egyptian agriculture, and its importance is due to its being an essential component of the Egyptian diet. Reliance on it is increasing for a large number of the population as a relatively cheap source of protein compared to high-priced animal protein, as the annual average per capita increased from about 6 kg /year in 1989 to about 7.7 kg/year in 2019 (Food Balance Bulletin) at a time when local production is shrinking and reliance on imports of beans increases to meet consumer needs and the increasing demand for beans. The bean crop and its by-products are also used to feed livestock and poultry, in addition to its role in improving soil properties and increasing the percentage of nitrogen in it, which helps to reduce the use of nitrogenous fertilizers for the next crop in agriculture.

The broad bean crop is planted in the winter season with crops of wheat, sugar beet and alfalfa, and in light of the scarcity and relative stability of the cultivated area, it has become difficult to increase the area of broad bean at the expense of any of them. Wheat agricultural policy aims to expand its area as a strategic crop, beet Sugar is subject to contract farming to meet the industrial needs of sugar production companies, and the state relies on it to increase sugar production after stabilizing the sugar cane crop area for considerations of rationalizing the use of irrigation water. Alfalfa is the main winter green fodder crop, in addition to the high net yield per feddan of these crops compared to the broad beans. This makes the vertical expansion programs for the broad bean crop and increasing the productivity of the

land unit a focus of increasing interest, especially with the existence of fundamental differences between the actual productivity of farmers and that achieved in research and extension fields (Salama, 2017).

The research problem was the marked decrease in the area and production of broad beans in general, and in the old lands in particular, as a result of the spread of weed (Orobanche) and agricultural pests, as well as the high costs of production requirements in addition to the policies adopted during the recent period were in the interest of bean farmers, which led to They have less incentive to grow the crop (Kandil, 2022).. The 2030 Sustainable Agricultural Development Strategy, including its policies and programs, aims to raise the self-sufficiency rate of the broad bean crop by increasing the feddan productivity from 1.4 tons/fed. in 2007 to 1.8 tons/fed. in 2030 (Ministry of Agriculture, 2009). Therefore, it is important to answer the following questions: How far are we from the maximum possible production? And how can it be achieved? What are the economic effects of achieving the productive efficiency of the broad bean production process?

The research mainly aimed to study the changes that occurred in the most important production and consumption indicators of the broad bean crop during the period (2006-2020), and to estimate the technical efficiency of the production of the broad bean crop in the old lands, and to determine the economic effects of achieving technical efficiency in the production process, from During the study of the following sub-objectives: First, The productive and economic indicators of the broad bean crop in Egypt. Second, The geographical distribution of the area planted with broad beans in Egypt. Third, estimating the technical efficiency of broad bean production in the old lands in the Egyptian governorates. Fourth, estimating the economic effects of achieving technical efficiency in the production of broad beans in the old lands.

Materials and Methods

In achieving its goals, the research relied on the secondary data published by the Central Agency for Public Mobilization and Statistics and the Egyptian Ministry of Agriculture and Land Reclamation through the Economic Affairs Sector, represented in the Agricultural Statistics Bulletin, Foreign Trade Statistics Bulletin for Agricultural Exports and Imports, Food Balance Bulletin, and Statistics Bulletin costs and net return.

In achieving its objectives, the research relied on the use of the descriptive economic analysis method, such as arithmetic averages, percentages, and coefficient of variation for some study variables. The quantitative analysis method, represented by simple regression analysis, was used to estimate the trend equations. Estimating technical competence using data envelope analysis (DEA) , which is A mathematical method nonparametric, Does not take into account random error in estimation, depends on the use of linear programming, The efficiency assessment for a group of production units is based on the optimal weights of inputs and outputs (Shafi, 2010), The programming model used under the assumption of constant return to capacitance (CRS) is as follows(Ali, Seiford,1993):

$$\text{Max}_{u,v}\ (u'y_i/v'x_i)$$
$$\text{St} \quad u'y_j/v'x_i \le 1 \qquad j= 1,2, ...N$$
$$U,v \ge 0$$

Where u represents the vector of output weights (M×1), V represents vector weights of the inputs (K×1), but this method gives many solutions and therefore the constraint v'xi=1 has been placed so that the model is as follows:

$$\text{Max}_{u,v}\ (u'y_i)$$
$$\text{St} \quad v'x_i = 1,$$
$$u'y_j - ux'_j \le 0, \quad j= 1,2, \ldots..,N,$$
$$U,v \ge 0,$$

The form Dual is usually used in estimation, not the previous multiplier, and it looks like the following (Charnes etal., 1995):

$$\text{Min}_{\theta,\lambda}\ \theta$$
$$\text{St} \quad - y_i + Y\lambda \ge 0$$
$$\theta x_i - X\lambda \ge 0$$
$$\lambda \ge 0$$

where λ is a vector (N×1) representing the weights of the items, and θ is the value of the technical proficiency index and its value ranges from zero to one. However, the analysis according to the assumption of the constant return to scale assumes that all units operate at the optimum scale, that is, the curve of the long-run average costs is horizontal, and this does not agree with the productive reality, so the previous model was developed by (Banker etal., 1984) to express the hypothesis Variable return to scale (VRS) and thus it was possible to separate capacitance efficiency from technical efficiency by adding convexity constraint (N1'λ = 1) where N1 stands for unit vector (N×1), and the model is as follows:

$$\text{Min}_{\theta,\lambda}\ \theta$$
$$\text{St} \quad - y_i + Y\lambda \ge 0$$
$$\theta x_i - X\lambda \ge 0$$

$N1'\lambda = 1$

$\lambda \geq 0$

The scale efficiency is the ratio between the two previous models, equal to CRS/VRS (Coelli, 1996).

Results and Discussion

First: The productive and economic indicators of the broad bean crop in Egypt during the period (2016-2020):

1. Productive indicators of the broad bean crop in Egypt during the period (2016-2020): By reviewing the data contained in Table No. (1) and the results of the statistical analysis contained in Table No. (2), it was found that the area planted with the broad bean crop ranged between a maximum of about 212 thousand feddans in 2007, and a minimum of about 69.8 thousand feddans in 2019. By estimating the trend equation, it was found It took a decreasing trend during the study period, with a statistically significant annual decrease rate estimated at 7.4% from the average period of about 126.5 thousand feddans, with an annual decrease of about 9.4 thousand feddans. The coefficient of variation was about 0.54, which indicates the instability of the broad bean area during the study period.

Table 1. Evolution of the most important productive and economic indicators of the broad bean crop in Egypt during the period (2006-2020)

Years	Area	yield	production	Total costs	farm price	total return	net return	Return on the pound
	thousand Feddan	Ard.*/fed.	thousand tons	pound/fed.	pound/ard.	pound/fed.	pound/fed.	pound
2006	175.4	9.01	247	2017	347	3398	1381	0.68
2007	212	8.97	302	2291	353	3506	1215	0.53
2008	170.1	9.08	244	3290	581	5666	2376	0.72
2009	206	9.15	295	3522	573	5701	2179	0.62
2010	183.7	8.09	232	3568	575	5133	1565	0.44
2011	131.4	8.16	174	4093	596	5567	1474	0.36
2012	97.9	8.76	139	4502	717	7107	2605	0.58
2013	104.9	8.84	156	4743	730	7286	2543	0.54
2014	89.7	8.79	132	4830	740	7359	2529	0.52
2015	81.4	8.48	119	5183	805	7707	2524	0.49
2016	83.4	8.22	119	5536	817	7635	2099	0.38
2017	121	8.57	170	8351	1286	11948	3597	0.43
2018	82.2	9.06	116	9478	1787	16462	6984	0.74
2019	69.8	9.16	99.15	10441	798	12844	2403	0.23
2020	89.1	9.2	124.6	10835	1870	18202	7367	0.68
Average	126.5	8.8	177.9	5445.3	838.3	8368.1	2922.7	0.57
C.V	0.54	0.04	0.53	0.26	0.24	0.24	0.24	0.27

**Ardab is a unit of weight equal to 155 kg of broad beans.*

Source: 1- Ministry of Agriculture and Land Reclamation, Agricultural Statistics Bulletin, various issues.

2- Ministry of Agriculture and Land Reclamation, cost and net income bulletin, various issues.

Table 2. Estimation of trend functions for the most important productive and economic indicators of the broad bean crop in Egypt during the period (2006-2020)

Items	**equation**	**F**	**R^2**	**% Annual growth rate**
Area	Ln Y = 5.36 - 0.074 T (-6.2)**	38.8**	0.75	7.4
Production	Ln Y = 5.69 - 0.072 T (-6.6)**	43.4**	0.77	7.2
Total costs per feddan	Ln Y = 7.54 + 0.116 T (13.8)**	190.3**	0.94	11.6
Farm price	Ln Y = 5.84 + 0.097 T (7.1)**	51.0**	0.80	9.7
Total return per feddan	Ln Y = 8.06 + 0.106 T (10.8)**	115.9**	0.89	10.6
Net return per feddan	Ln Y = 7.17 + 0.084 T (4.08)**	16.7**	0.56	8.4

*** Significant at 1% probability level*

Source: calculated from the data in Table No. (1).

The production of the broad bean crop ranged between a maximum of about 302 thousand tons in 2007, and a minimum of about 99.15 thousand tons in 2019. By estimating the trend equation, it was found that it took a decreasing trend

during the study period with a statistically significant annual decrease rate estimated at 7.2% of the average period The amount is about 177.9 thousand tons, an annual decrease of about 12.8 thousand tons. The coefficient of variation was about 0.53, which indicates the instability of broad bean production during the study period. The production of the broad bean crop during the study period is affected up and down according to the cultivated area, where the feddan productivity was characterized by relative stability during the study period, with an average of about 8.8 ard./fed., and a low coefficient of variation of about 0.04 during the study period.

2. Economic indicators of the broad beans crop in Egypt during the period (2016-2020): By reviewing the data contained in Table No. (1) and the results of the statistical analysis contained in Table No. (2), it was found that the total production costs per feddan of the broad bean crop ranged between a maximum of about 10,835 pounds in 2020, and a minimum of about 2017 pounds in 2006. By estimating the trend equation It was found that it took an increasing trend during the study period with a statistically significant annual growth rate estimated at about 11.6% from the average period of about 5445.3 pounds, with an annual increase of about 631.7 pounds. The coefficient of variation was about 0.26, which indicates the instability of the costs of producing feddans of broad beans during the study period, albeit to a lesser degree than the instability of area and production. It is noted from the data the impact of the liberalization of the exchange rate in November 2016, which led to an increase in production costs in 2017, by about 51% compared to 2016.

The farm price of the broad bean crop ranged between a maximum of about 1870 pounds/ardab in 2020, and a minimum of about 347 pounds/ardab in 2006. By estimating the trend equation, it was found that it took an increasing trend during the study period with a statistically significant annual increase rate estimated at about 9.7% of The average period of about 838.3 pounds/ardab, with an annual increase of about 81.3 pounds/ardab. It is noted that the agricultural price was affected in 2019 with the onset of the Corona pandemic and some measures were taken, including preventing the export of local beans with the opening of the import door and with the precautionary measures related to the closure of restaurants and the weak local demand during that period, which led to a decrease in the agricultural price in 2019 by 55.3% than it was in 2018 which was reflected in the decline in revenue, net return and the return on the pound spent in 2019. While the total revenue per feddan of the broad beans crop ranged between a maximum of about 18,202 pounds in 2020, and a minimum of about 3398 pounds in 2006. By estimating the trend equation, it was found that it took an increasing trend during the study period with a statistically significant annual increase rate estimated at 10.6% of the average period the amount is about 8,368 pounds, with an annual increase of about 887 pounds. While the net yield per feddan of the broad bean crop ranged between a maximum of about 7367 pounds in 2020, and a minimum of about 1215 pounds in 2007. By estimating the trend equation, it was found that it took an increasing trend during the study period with a statistically significant annual increase rate estimated at 8.4% of the average The period of about 2,922.7 pounds, with an annual increase of about 245.5 pounds. Finally, the return on the pound spent on the broad bean crop ranged between a maximum of about 0.74 pounds in 2018, and a minimum of about 0.23 pounds in 2019 with an annual average of about 0.57 pounds during the study period.

Second: The geographical distribution of the area planted with broad beans in Egypt during the period (2006-2020): From reviewing the data in Table (3), it is clear that the area planted with the broad bean crop in the old lands during the study period, after it was 125.5 thousand feddans at the beginning of the period, decreased to about a third at the end to reach about 42.8 thousand feddans in 2020. The decline began significantly at the beginning of the period From 2011 until it reached the lowest area in 2019 by about 25.9 thousand feddans, and thus its relative importance decreased from about 70% of the total area planted with broad beans at the beginning of the period to about 37.2 at the end of the period, with an average of about 80 thousand feddans, representing about 60% of the total The area planted with fava beans. While the area of broad bean in the new lands inside the valley during the study period decreased from about 20 thousand acres as an average for the first three years of the study period to about 14.4 thousand acres as an average for the last three years. About 10.5% at the beginning of the period to about 18% at the end of the period of the total area of the broad bean crop. With an average of about 15.6 thousand feddans, representing about 13% of the total area planted with broad beans. While the area planted with broad beans in the new lands outside the valley was relatively stable, with an average of about 31 thousand feddans, representing about 27% of the total area planted with broad beans. However, its relative importance increased during the study period as a result of the decrease in the areas planted with the crop in the old lands from about 18.5% at the beginning of the period to about 40% at the end of the period of the total area of the broad bean crop. It should be noted that 78% of the area of broad beans in the new lands outside the valley is concentrated in the Nubariya area, with an area of about 24.9 thousand feddans, according to data from the Ministry of Agriculture in 2020.

Table -3 Geographical distribution of the area planted with broad beans in Egypt during the period (2006-2020)

Year	Old lands in the valley		New lands in the valley		New lands outside the valley		Total area	
	thousand feddan	%	thousand feddan	%	thousand feddan	%	thousand feddan	%
2006	125.5	71.6	18.1	10.3	31.7	18.1	175.4	100

2007	145.6	68.7	21.8	10.28	44.6	21.02	212	100
2008	120.6	70.91	19.7	11.61	29.7	17.49	170.1	100
2009	148.2	71.93	25	12.13	32.8	15.94	206	100
2010	130.4	71	21.4	11.65	31.9	17.35	183.7	100
2011	86.4	65.71	15.5	11.76	29.6	22.52	131.4	100
2012	59	60.22	13.8	14.09	25.2	25.69	97.9	100
2013	68.1	64.94	10.9	10.41	25.9	24.65	104.9	100
2014	50	55.71	10.3	11.46	29.5	32.83	89.7	100
2015	42.8	52.25	10.6	12.91	28.5	34.84	81.9	100
2016	48.2	57.8	8.5	10.21	26.7	31.99	83.4	100
2017	72.9	60.26	15.1	12.49	33	27.25	121	100
2018	33.5	40.79	16.3	19.83	32.4	39.38	82.2	100
2019	25.9	37.16	12.3	17.56	31.6	45.29	69.8	100
2020	42.8	48.06	14.6	16.4	31.7	35.54	89.1	100
Average	80	60	15.6	13	31	27	127	100

Source: Ministry of Agriculture and Land Reclamation, Agricultural Statistics Bulletin, various issues.

Third: Estimating the technical efficiency of broad bean production in the old lands in the Egyptian governorates as an average for the period (2018-2020): The technical efficiency of producing the broad bean crop in the old lands in the governorates producing it was estimated using the data envelope analysis method, and the production inputs were represented in only two inputs, the first is the work expressed in its monetary value in pounds and it includes both human labor and machine work, the second is capital and represents the value of production requirements expressed in pounds, while outputs were feddan productivity, expressed in ardabs. The analysis was conducted according to the two assumptions of constant return to Scale l (CRS) and variable return to Scale (VRS) so that Scale efficiency can be separated from technical efficiency. The analysis was also done according to the concept of production inputs, which is commensurate with the nature of agricultural production. It is clear from the data and results of the analysis presented in Tables No. (4), (5) with regard to the quantity of inputs used in the production of the broad bean crop, that the value of the capital input ranged between a maximum of about 1754 pounds/feddan in Fayoum governorate, and a minimum of about 1113 pounds/feddan in Alexandria Governorate, with an average of about 1439 pounds/feddan. While the value of the work input ranged between a maximum of about 4,944 pounds/feddan in Sohag governorate, and a minimum of about 3500 pounds/feddan in Qena governorate, with an average of about 4172 pounds/feddan. While the amount of output represented in the feddan productivity of the broad bean crop ranged between a maximum of about 10.59 ardabs/feddan in Dakahlia Governorate, and a minimum of about 6.54 ardabs/feddan in Fayoum governorate, with an average of about 8.29 ardabs/feddan.

Table 4. Estimating the technical efficiency of broad bean production in the old lands in the Egyptian governorates as an average for the period (2018-2020)

Governorates	Inputs		Outputs	Technical efficiency		Scale efficiency	
	Capital Pound	labor Pound	yield Ardab	CRS %	VRS %	SE %	Return to Scale
Alexandria	1113	4310	8.26	0.98	0.99	0.99	irs
Behera	1517	3768	8.57	0.89	0.99	0.9	irs
Gharbia	1315	4039	7.93	0.83	0.93	0.89	irs
Kafr El-Sheikh	1593	4195	7.91	0.74	0.86	0.86	irs
Damietta	1570	4175	9.78	0.92	0.96	0.96	irs
Dakahlia	1543	4150	10.59	1	1	1	-
Sharkia	1694	4423	8.96	0.79	0.86	0.92	irs
Ismailia	1598	4322	7.44	0.68	0.81	0.83	irs
\Fayoum	1754	3559	6.54	0.72	0.98	0.73	irs
Menia	1262	4230	9.56	1	1	1	-
Assuit	1048	4295	7.96	1	1	1	-
Suhag	1717	4944	8.16	0.67	0.75	0.9	irs
Qena	1238	3500	7.36	0.85	1	0.85	irs
Aswan	1190	4502	6.99	0.77	0.92	0.85	irs
Average	1439	4172	8.29	0.85	0.93	0.91	

TE : Technical Efficiency CRS : Constant Returns to Scale
VRS :Variable Returns to Scale SE : Scale Efficiency
Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Cost and Net Return Statistics Bulletin, Efficiency Analysis Results using DEAP v.2.1.

Table 5. The Frequent Distribution of the Estimated Technical Efficiency Values for the Egyptian Governorates Producing the broad Bean Crop as an Average for the Period (2018-2020)

category	governorates number of		
	CRS	VRS	SE
1	3	3	3
0.90 – 1.00	2	5	5
0.80 – 0.90	3	5	5
0.70 – 0.80	4	1	1
0.60 – 0.70	2	0	0

Source: compiled and calculated from: The results of competency analysis using DEAP v.2.1 program, shown in Table No. (4).

From the estimated values of the technical efficiency of the governorates producing broad beans, according to the assumption of constant return to scale, it was clear that the full efficiency was achieved in three governorates, namely Dakahlia, Minia and Assiut, and two governorates with efficiency values ranging from 0.90 to less than one true, namely Alexandria, Damietta, with a value of about 0.98, 0.92 for each. respectively, and the number of three governorates whose efficiency values range from 0.80 to less than 0.90, namely, Beheira, Qena and Gharbia, with a value of about 0.89, 0.85, 0.83 for each of them, respectively, and the number of four governorates whose efficiency values range from 0.70 to less than 0.80, which are Sharkia, Aswan, Kafr El-Sheikh And Fayoum with a value of about 0.79, 0.77, 0.74, 0.72 for each of them, respectively, and two governorates with efficiency values ranging from 0.60 to less than 0.70, which are Ismailia and Sohag with a value of 0.68 and 0.67 each, respectively. The average value of the efficiency of the Egyptian governorates producing municipal beans is about 0.85, meaning that the productivity of a feddan can be increased by about 15% using the same amount of inputs used assuming that all farms operate at the optimum scale, which is an unrealistic assumption.

From the estimated values of the technical efficiency of the governorates producing broad beans according to the hypothesis of the variable return to scale, it became clear that the full efficiency was achieved in three governorates, namely Dakahlia, Minia and Assiut, and a number of five governorates. A value of about 0.99, 0.99, 0.98, 0.96, 0.93 for each of them, respectively, and the number of five governorates whose efficiency values range from 0.80 to less than 0.90, which are Gharbia, Kafr El-Sheikh, Qena, Aswan and Ismailia, with a value of about 0.89, 0.86, 0.85, 0.85, 0.83 For each of them, respectively, and one governorate, Sohag, with an efficiency of 0.75. The average efficiency value of the Egyptian bean-producing governorates was about 0.93, meaning that the productivity of a feddan can be increased by about 7% by using the same amount of inputs used in the production of broad bean production. With regard to scale efficiency, it was found that three governorates operate at their optimum scale, namely, Dakahlia, Minia and Assiut, and five governorates at scale ranging from 0.90 to less than one integer of the optimum scale, which are Alexandria, Damietta, Sharkia, Beheira and Sohag with a value of about 0.99, 0.96, 0.92, 0.90, 0.90 for each of them, respectively, and the number of five governorates with a scale ranging from 0.80 to less than 0.90 of the optimal scale, which are Gharbia, Kafr El-Sheikh, Qena, Aswan, Ismailia with a value of about 0.89, 0.86, 0.85, 0.85, 0.83 for each of them arrangement, and one governorate, Fayoum, with an efficiency of 0.75 of the optimum scale. With regard to the nature of the return to scale, it was found that there are three governorates characterized by a constant return to scale, which are Dakahlia, Minya and Assiut, meaning that increasing all inputs by a certain percentage leads to an increase in outputs by the same percentage, while the rest of the governorates are characterized by an increased return to scale, meaning that increasing the inputs by a certain percentage leads to an increase in the outputs by Larger.

Fourth: Estimating the economic effects of achieving technical efficiency in the production of broad beans in the old lands: The economic effects of achieving technical efficiency for the production of the broad bean crop can be addressed on two levels. The first is the level of the farm, especially related to reducing production costs, which is reflected in an increase in the net return of the feddan for the farmer. The second is the level of Egyptian agriculture, in particular, the effects related to the scarcest agricultural resources, which is land and water.

1. The economic impact of achieving technical efficiency in the production of the broad bean crop at the farm level: From the data contained in Table No. (6), which shows the targeted quantities of agricultural inputs that achieve technical efficiency without reducing the production quantity, based on the data envelope analysis, it is possible to reduce the average value of the capital used in the production process to about 1269 pounds, that is, there is a surplus in The use of the capital amounted to about 170.2 pounds, representing about 11.8% of the value of the actual capital used in the production of feddans of the broad bean crop. It is also possible to reduce the average value of the labor used in the production process to about 3870 pounds, meaning there is a surplus in the use of labor amounting to about 301.8 pounds, representing about 7.2% of the value of the actual work used in the production of feddans of the broad bean crop. Accordingly, the total target value of capital and labor together amounted to about 5139 pounds, which is less than the actual total value of them by about 8.4%, which is equivalent to 472 pounds, which is reflected in reducing the costs of acre production and increasing the net return of the bean farmers by the same amount.

2. The economic impact of achieving technical efficiency in the production of the broad bean crop on the level of Egyptian agriculture: It is clear from the data in Table No. (7) that achieving technical efficiency in the production of the broad bean crop in the old lands achieved savings in the agricultural land and irrigation water, which are the most scarce suppliers in agriculture, as the average area of the municipal bean crop in the old lands for the period (2018-2020) It reached about 34.07 thousand feddans, with an actual average productivity of about 8.29 ardabs/feddan. It was found from the efficiency using the data envelope analysis that productivity can be increased by 7%, which is equivalent to 0.58 ardabs/feddan. The area is about 19.76 thousand ardabs, this increase could have been achieved by horizontal expansion with an area of about 2384 feddans. The average water rating of the municipal bean crop in Egypt is estimated at about 1691 cubic meters, meaning that achieving technical efficiency in the production of the broad bean crop achieves a water saving estimated at about 4.03 million cubic meters, which is the amount needed to cultivate the area of horizontal expansion in the crop.

Table 6. The economic impact of achieving technical efficiency in the production of the broad bean crop in the Egyptian governorates on reducing production inputs as an average for the period (2018-2020)

Governorates	Actual		target		surplus	
	Capital pound	labor pound	Capital pound	labor pound	Capital pound	labor pound
Alexandria	1113	4310	1098	4252	14.9	57.5
Behera	1517	3768	1352	3743	164.4	24.8
Gharbia	1315	4039	1223	3755	92.5	284.1
Kafr El-Sheikh	1593	4195	1290	3611	303.4	584.3
Damietta	1570	4175	1467	3987	103.5	188
Dakahlia	1543	4150	1543	4150	0	0.3
Sharkia	1694	4423	1389	3822	304.9	601.4
Ismailia	1598	4322	1246	3516	352.1	805.6
Fayoum	1754	3559	1238	3500	516.3	59
Menia	1262	4230	1262	4230	0	0
Assuit	1048	4295	1048	4295	0	0
Suhag	1717	4944	1286	3704	431.1	1240
Qena	1238	3500	1238	3500	0.3	0
Aswan	1190	4502	1089	4122	100.6	380.1
Average	1439	4172	1269	3870	170.2	301.8
Total	5611		5139		472	

Source: compiled and calculated from: The results of competency analysis using DEAP v.2.1 program, shown in Table No. (4).

Table 7. The economic impact of achieving technical efficiency in the production of the broad bean crop on the level of Egyptian agriculture as an average for the period (2018-2020)

Item	Unit	Value
The average area of the broad bean in the old lands	thousand feddan	34.07
Actual average yield	Ardab/feddan	8.29
Average technical efficiency of production in old lands	%	93
Possibility to increase productivity	%	7
Amount of increase in feddan yield	Ardab/feddan	0.58
Amount of increase in production	Ardab	19761
The area corresponding to the horizontal expansion	Feddan	2384
Average water ration per feddan of broad beans	Cubic meter	1691
The savings in the water used	million cubic meters	4.03

Source: 1. Collected and calculated from: The results of efficiency analysis using DEAP v.2.1 program, shown in Table No. (4).

2. Central Agency for Public Mobilization and Statistics, Irrigation and Water Resources Annual Bulletin, 2020.

Conclusion

in light of the findings of the study, it was found that despite the positive results of raising the technical efficiency of the broad bean production process in the old lands, in light of the suffering of bean production from the endemicity of weed and agricultural pests in those lands, there is a difficulty in raising the feddan productivity Even with achieving technical efficiency in the production process to reach about 8.87 ardabs/feddan, which is equivalent to 1.37 tons/feddan, it is still less than the target to be achieved according to the strategy of the Ministry of Agriculture (1.6 tons/feddan in 2017, 1.8 tons/feddan in 2030). Therefore, the study recommends expanding the cultivation of the broad bean crop in the new and newly reclaimed lands, with more research efforts being made to devise varieties that are resistant to the crop's pests and with high productivity to improve crop production and achieve an acceptable level of self-sufficiency.

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