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Estimating the levels of economic efficiency of yellow corn crop farms in Kirkuk Governorate - Hawija district (a model) For the production season 2022 AD

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ABSTRACT
The study aimed to estimate the technical, Allocative and economic efficiency of the yellow maize crop in Kirkuk Governorate - Hawija based on the data envelope analysis (DEA) technique. Its percentage in the community is for (70) farms, and using the program (Deap) to analyze efficiency according to the data envelope method. DEA data envelope analysis in two directions according to the concept of stability and change of return to capacity, which allows estimating technical efficiency and capacity efficiency, and using the same method, specialized efficiency and economic efficiency were extracted. The production process now has an 85% technical efficiency rate on average. The standard rate technical effectiveness obtained (95%) taking into account the change in return to Scale. The results showed that a certain percentage of farms had reached Allocative efficiency (AE) at a level of (100%) varied depending on the cost function variables,they are (4) farmers, and the average rate of economic efficiency (EE) ((82%), and the study concluded that the farmers of the yellow corn crop do not achieve reaching the optimal size of production, and this means that there is a drift from the optimal size of the crops of the study sample. In the light of the results that have been reached, the study recommended taking advantage of the efficiency indicators obtained through the data envelope model

تقدير مستويات الكفاءة الاقتصادية لمزارع محصول الذرة الصفراء في محافظة كركوك- قضاء الحويجة (أنموذجاً) للموسم الإنتاجي 2022م

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الخلاصة

هدفت الدراسة الى تقدير الكفاءة التقنية والتخصيصية والكفاءة الاقتصادية لمحصول الذرة الصفراء في محافظة كركوك-قضاء الحويجة وفق اسلوب تحليل مغلف البيانات(DEA)، وتم الحصول على البيانات من خلال تصميم استمارة استبانة باستعمال اسلوب العينة العشوائية للمزارع ميدانياً وتم تحديد حجم العينة لمحصول الذرة الصفراء حسب عددها في المجتمع ل(70) مزرعة ، وباستخدام برنامج(Deap) لتحليل الكفاءة وفق اسلوب مغلف البيانات، واعتمدت الدراسة على التحليل الوصفي والكمي الذي يستند الى اسس ومبادئ ومفاهيم النظرية الاقتصادية واساليب التحليل الرياضية في اختبار فرضيات الدراسة وتحقيق اهدافها من خلال تطبيق اسلوب تحليل مغلف البيانات DEA وباتجاه ادخالي وفقا لمفهوم ثبات وتغير العائد للسعة مما يسمح بتقدير الكفاءة التقنية وكفاءة السعة، وباستخدام ذات الاسلوب تم استخراج الكفاءة التخصيصية والكفاءة الاقتصادية وتم التوصل نتائج تحليل الكفاءة وفق مغلف البيانات للانتاج والتكاليف بثبات وتغير عوائد السعة وقد اظهرت نتائج التحليل وبالاعتماد على متغيرات دالة الإنتاج, اذ بلغ نسبة متوسط الكفاءة الفنية**(85%)** اما الكفاءة الفنية في ظل تغير العائد للسعة فلقد بلغت نسبة متوسط الكفاءة الفنية (95%) وبالاعتماد على متغيرات دالة التكاليف اظهرت النتائج ان عدد المزارع التي حققت كفاءة سعرية(AE) بمستوى(100%)هم**(4)** مزارع وبلغت نسبة متوسط الكفاءة الاقتصادية(EE) (82%) واستنتجت الدراسة ان مزارعو محصول الذرة الصفراء لا يحققون الوصول الى الحجم الامثل للإنتاج وهذا يعني وجود انحراف عن الحجم الأمثل لمحاصيل عينة الدراسة، وعلى ضوء النتائج التي تم التوصل اليها اوصت الدراسة بالاستفادة من مؤشرات الكفاءة التي تم الحصول عليها من خلال أنموذج مغلف البيانات.

الكلمات المفتاحية: التكاليف، مغلف البيانات، الكفاءة التخصيصية

INTRODUCTION

Yellow corn constitutes the main food for many countries in the world, as it is used in the production of corn oil, starch, and corn flour, in addition to its use as animal feed, and its entry into many industries and fields of energy and biofuel production. The yellow maize crop ranks third in the world after wheat and rice in terms of cultivated area and production, and the most important regions producing it in the world are North and South America, Eastern Europe, Russia, China, India and South Africa, while in Iraq it ranks fourth after wheat, rice and barley, where the cultivated area is It is relatively small due to competition from other summer crops such as cotton, potatoes, etc. Kirkuk Governorate’s production of yellow corn for the current season amounted to 536,399 thousand tons on an area of 230,000 dunums using the sprinkler irrigation method. The quantities produced from the yellow corn crop in Hawija district amounted to more than 16,556,910 tons. “Kirkuk leads the Iraqi governorates in producing yellow corn, which necessitated the need to find marketing outlets to support the farmer and encourage him to grow this crop, and since it is a crop Yellow corn ranked first among cereal crops, so this study was conducted in Hawija district to estimate the efficiency levels of yellow corn farms using sprinkler irrigation, which would encourage farmers to grow this crop in the study area.

Research Importance

The importance of the research stems from the importance of the crop under study, as farmers seek to increase production of yellow maize in the Hawija district in order to achieve economic efficiency and optimal exploitation of resources. This criterion is considered one of the main criteria for achieving economic efficiency through the use of the data encapsulation method, which is considered one of the most important. Accurate metrics in calculating efficiency levels for each farm.

Research problem

Many farmers in Hawija district, especially yellow maize farmers, suffer from many production obstacles, including high production costs, such as the prices of economic resources such as seeds, fertilizers, control materials, and pesticides, or importing them from outside the country, which requires the optimal use of these resources and work to increase production through... Raising the level of efficiency that contributes in one way or another to controlling the productivity of the yellow maize crop.

Research Aims

Based on the research problem, this research aims to:

1- Estimating the technical, allocative and economic efficiency of yellow maize farms in Hawija District from the side of production and costs.

2- Diagnosing efficient farms and finding out how far others are from optimal sizes

Research Hypothesis

The study includes the assumption that yellow maize farmers in the Hawija district are far from technically efficient production levels, as well as the inability of farmers to achieve economic efficiency or approach the efficiency levels of yellow maize production farms in the study area.

Data Sources:

Data were obtained by designing a questionnaire using the random sampling method for farmers in the field. The size of the sample was determined according to its percentage in the community. (70) questionnaires were collected and all of them were entered into the study plan and represented by (10%) of the study population. The program (Deap) was used to analyze Efficiency under the data envelope method

Search Style

The study relied on descriptive and quantitative analysis, which is based on the foundations, principles and concepts of economic theory and mathematical, statistical and analogical analysis methods to test the study's hypotheses and achieve its objectives by applying the data envelopment analysis method (DEA) to production functions and cost functions in two directions in accordance with the concept of stability of return to capacity (CRS) of Scale and change of return. For Scale (VRS), which allows for the estimation of technical efficiency (TE) and Scale efficiency (SE), allocative efficiency (AE) and economic efficiency (EE) are also extracted, and this model is estimated in light of the change in the return to capacity from the input side (input guidance).

Theoretical Framework

Economic efficiency is defined as the use of sources of wealth in a way that can achieve greater production with the same previous production costs, or achieve the same previous production with lower production costs, and it can also be defined as obtaining the largest amount of return at the same cost or obtaining the same return at a lower cost, and economic efficiency A concept that includes technical and distributional efficiency and an effective tool that contributes to helping to achieve the sustainability of scarce resources by ensuring optimal use. (Kehude and Awoyemi , 2009)

Components of Economic Efficiency Implication Economic

Between Farrel (1957; 253) that economic efficiency includes both technical efficiency and allocative efficiency. The following is the definition of these components:

Technical Efficiency (TE):

Technical efficiency is one of the elements of overall economic efficiency. However, in order for the farm to be economically effective, it must be technically efficient.(John & Sabine , 2019) Input Oriented technical efficiency refers to the ability to reduce the use of material inputs for a certain level of output (Osborne and Trueblood , 2006)

Allocative Efficiency (AE):

The specialized efficiency reflects the ability of the farm to use the sieves in optimal proportions according to the prices of these sieves and the technology used. (Emrouznejad, etal 2014). The matter does not take into account here only the efficiency with which the resources are used, but also the efficiency with which the production is distributed. The specialized efficiency is achieved when the resources are allocated and the optimal size is achieved in order to reach to the welfare of society. (Obiero , 2010)

Measurment Economic Efficiency:

The measure of economic efficiency is a composite measure of technical efficiency and allocative efficiency. Thanks for its clarification are given to (Farrell, 1957). Accordingly, there are two ways to measure economic efficiency.

(Input Orientated Measures), and the second is on the output side and is called the measurement of economic efficiency with output orientated measures.

Methods to Estimate - Economic Efficiency

Economic efficiency can be estimated through traditional and modern methods, and one of the most important methods of traditional estimation is the definite statistical method (OLS), while modern methods represent standard parametric methods. Non-parametric) known as Data Envelope Analysis (DEA) and a parametric or (parametric) method known as the Random Border Analysis method.(Huguenin , 2012) In this study, economic efficiency will be estimated in the traditional way through cost functions as well as estimated by Data Envelope Analysis (DEA)

Data Envelope Analysis (DEA) Method:

The method of data envelope analysis or empirical analysis of data is considered one of the non-parametric methods, and the merits of building (DEA) are given to the scientist Edwardo Rhodeso in 1978, when he developed the construction of the (DEA) system using it to build a system of multiple inputs and outputs. The location of the boundary efficiency curve is determined through extreme observations extreme. (Ali and Farhan, 2015). The concept of (DEA) is based on an article published by Farell in 1975. This concept is based on the simple fact that any facility that uses fewer inputs than others to produce the same level of production is considered more efficient, and the boundary efficiency curve according to the concept of (DEA) is formed by finding a hypothetical production unit It expresses the best variety of observations for the ratio of outputs to inputs, and this curve encircles or envelops all observations under study (Al-Mohammad et al., 2018)

MATERIALS AND METHODS OF WORK

Description of the economic efficiency measurement model and its constituent parts according to the production function's variables.

Since The farmer, in other words, controls his inputs more than he does his outputs (production) as a result of the environmental conditions surrounding the farm, the cost of inputs can be reduced or reduced in a more secure way Estimating Rather than boosting output and in the presence of field data, the technical efficacy of the inputs for the crop of the study sample is required. The sample farms' overall production (N) is a representation of the dependent factor (M), which is statistically represented by (K) of the inputs, including (quantity of seeds/g), "quantity of fertilizers/kg," "quantity of pesticides/liter," "quantity of mechanical work/hour," and "quantity of manual labor/worker." The technical effectiveness of the inputs was evaluated using the Data Envelope Analysis (DEA) approach. Considering the modification in capacity returns (VRS) is transformed as follows by applying the Duality theory to linear programming:

$Min_{\theta,\lambda}\theta$

Subject to:

$yi + y\lambda \geq 0-$

$\theta xi - X\lambda \geq 0$

$Ni\lambda = 1$

$\lambda \geq 0$

Since:

Xi= input vector.

Yi = output vector.

λ = resultant vector.

Ni= expresses the constants and weights associated with efficient farms.

θ: represents the value of the farmer's technical efficiency index and falls between (0-1).

It requires measuring the SE capacity efficiency of the farmer in light of the stability and change of capacity returns.

Description of the economic efficiency measurement model and its components in light of the variables in the cost function

Technical efficiency TE, allocative efficiency AE, and cost efficiency CE will be estimated based on the cost function. Costs associated with (seed, fertilizer, pesticides, mechanical work, and manual labor) Thus under the assumption that returns to scale change, the linear programming model is as follows:

Min λ , $Xi^{*}wiXi$

Subject to :

$-y_i + y\lambda \geq 0$

$\boldsymbol{\theta} X_i^{*} - X\lambda \geq 0$

$\lambda \geq 0$

Since:

Xi = vector to minimize the cost of unit production i.

Wi = vector of input prices.

yi = output vector for production unit i.

Economic efficiency (EE), which is determined by the ratio of the minimum cost to the actual cost, is calculated through the following equation: -

$$EE = \frac{W_i\, {X_i}^{*}}{W_i\, X_i}$$

What is the result of augmenting technical competence by specialized competence in terms of economic efficiency AE = EE/TE, In addition to dividing economic efficiency by technical efficiency to arrive at the specialized competence EE = TE * AE.

RESULTS AND DISCUSSION

Table (1) summarizes and interprets the findings from the estimation and presentation of each degree according to the elements impacting the production function, Regarding the yellow corn crop's Scale efficiency, volume output, and technical efficiency. Given the consistency of the return on c Scale, the study sample's return on Scale for the productive season (2022) ranged from a minimum of (4%) for a group of farms totaling (29), from farm No. (58) to a maximum of (100%), which represented a percentage of (41%) farms., Considering that Technical efficiency was generally (85%), these farms could either boost production of the yellow corn crop by 15% or maintain current production levels by reducing the cost by 15%.The return on c Scale varied even more, with farm number 36 having a minimum return on capacity of 75% and farm number 44 having a maximum return on Scale of 100%. with the yellow corn harvest accounting for a percentage of (62%) of the total., While the average technical efficiency rate was 95%, this suggests that production might be increased in accordance with this principle by 5% without using more resources.

It should be mentioned that (29) farms, or 41% of all the farms in the sample under study, were those who attained full technical efficiency by (100%), Such are the farms that might be regarded as farms that were operating along the production potential curve. An example for the remaining Inefficient farms are considered among those whose output deviates from the production potential curve to varied degrees. This implies that technologically advanced farms either use less input to achieve the same level of production or more input to achieve the same level of production, either Reviewing the capacity efficiency statistics reveals that they were likewise diverse, ranging from (1-0.439) with a rate of 89% on average. This means that these farms have the option of increasing their production by (11%) or using less of their available financial resources for that purpose. It entails a (11% cost reduction). Regarding There were 41 farms operating successfully and producing rising returns, or (58%) of the overall sample under examination. No farm operating with declining capacity returns was noted in the study sample, and this suggests The amount of output is growing more quickly than the components of production that are actually utilised in the production process, nevertheless.

Table 1: Technical efficiency and capacity efficiency under the constant and variable returns to capacity

Yields volume	Scale efficiency	Technical Efficiency with variable returns (vrste)	Technology Efficiency Constant Returns (crste)	Farm	Yields volume	Scale efficiency	Technical Efficiency with variable returns (vrste)	Technology Efficiency Constant Returns (crste)	Farm
-	1.000	1.000	1.000	38	Irs	0.882	0.825	0.727	1
Irs	0.677	0.988	0.669	39	-	1.000	1.000	1.000	2
Irs	0.985	0.865	0.852	40	Irs	0.992	0.935	0.928	3
Irs	0.677	0.988	0.669	41	Irs	0.742	1.000	0.742	4
-	1.000	1.000	1.000	42	Irs	0.924	0.776	0.717	5
-	1.000	1.000	1.000	43	Irs	0.835	0.998	0.833	6
Irs	0.439	1.000	0.439	44	-	1.000	1.000	1.000	7
-	1.000	1.000	1.000	45	Irs	0.924	0.776	0.717	8
-	1.000	1.000	1.000	46	-	1.000	1.000	1.000	9
-	0.941	1.000	0.941	47	Irs	0.970	1.000	0.970	10
-	1.000	1.000	1.000	48	Irs	0.874	0.918	0.802	11
irs	0.907	0.810	0.734	49	-	1.000	1.000	1.000	12
Irs	0.924	0.776	0.717	50	Irs	0.987	1.000	0.987	13
Irs	0.713	0.958	0.683	51	Irs	0.860	0.864	0.743	14
Irs	0.857	0.907	0.777	52	-	1.000	1.000	1.000	15
-	1.000	1.000	1.000	53	-	1.000	1.000	1.000	16
irs	0.924	0.776	0.717	55	-	1.000	1.000	1.000	17
-	1.000	1.000	1.000	56	Irs	0.777	1.000	0.777	18
irs	0.845	0.970	0.820	57	-	0.958	0.967	0.926	19
irs	0.516	0.832	0.429	58	Irs	0.852	1.000	0.852	20
-	1.000	1.000	1.000	59	-	1.000	1.000	1.000	21
irs	0.972	1.000	0.972	60	Irs	0.583	1.000	0.583	22
-	1.000	1.000	1.000	61	Irs	0.457	1.000	0.457	23
irs	0.860	0.960	0.826	62	-	1.000	1.000	1.000	24
irs	0.914	0.844	0.771	63	Irs	0.920	0.793	0.729	25
-	1.000	1.000	1.000	64	-	1.000	1.000	1.000	26
-	1.000	1.000	1.000	65	-	1.000	1.000	1.000	27
irs	0.808	1.000	0.808	66	Irs	0.756	1.000	0.756	28
-	1.000	1.000	1.000	67	Irs	0.710	1.000	0.710	29
irs	0.770	0.843	0.649	68	-	1.000	1.000	1.000	30
-	1.000	1.000	1.000	69	Irs	0.885	1.000	0.885	31
irs	0.909	1.000	0.909	70	Irs	0.911	0.878	0.800	32
					Irs	0.809	1.000	0.809	33
					-	1.000	1.000	1.000	34
Average	**0.890**	**0.955**	**0.852**		Irs	0.833	1.000	0.833	35
The lowest value	**0.439**	**0.752**	**0.429**		Irs	0.876	0.752	0.659	36
highest value	**1**	**1**	**1**		Irs	0.517	0.920	0.475	37

Based on information from the survey, as determined by the Deap data envelope analysis program

Using the Data Envelope Analysis (DEA) approach, Technical Efficiency (TE) and Allocative Efficiency (AE), which are parts of the total economic efficiency (EE), were calculated for the yellow corn crop farms in the Hawija region for the production season (2022).

The findings Table (2) lists the levels of estimating technical efficiency (TE), allocative efficiency (AE), and economic efficiency (EE). in accordance with using the cost function's variables, using resource costs and quantities while assuming a change in capacity returns. Given the change in the study sample's capacity output, the levels of technical efficiency ranged between (1 - 0.779), with an average of (95%), according to the findings that were attained and shown in the aforementioned table. Regarding the levels of growers' allocative efficiency (AE), of yellow corn, it turned out that they ranged between (0.55%) for a number of farms, ranging from (100%) for farm No. 24 to (4) farms for the yellow corn harvest. and made up (5% of the sample for the study of this crop). The average percentage of it was 86%, and this shows that redistributing the financial resources used to grow the yellow corn crop in the Hawija district can lower costs without lowering production levels or produce more of the output at the cost-in-use right now. When the slopes of the cost line (allocation ratio) and the isoquant curve (marginal rate of substitution) are equal, output maximization is achieved. The point of tangency between the cost line and the isoquant curve, which is where the farmer will be able to reach the ideal production level, Therefore, these farms don't It has the potential to choose the ideal resource combination because Especially during the start of the production season, the majority of production resources are bought from the market at high costs, notably in the lack of support from the government, which is evident in its effects on allocative efficiency, Therefore, these farms don't Due to the high cost of most production inputs purchased on the open market, It has the capacity to choose the best resource combination, particularly at the beginning of the production season and especially without government support for it, which is reflected in its impact on the allocative efficiency, Due to their consumption of all inputs at an adequate or optimal level to achieve the required production, There are no surplus inputs on these farms. Referring to Table (2)'s findings, we also observe that not all of the farms that reached optimal technical efficiency (complete) simultaneously managed to attain pricing effectiveness at its highest degree, and the reason for this is that the high cost of manufacturing elements decreased efficiency. This indicates that the production is sold at a price where it is both technically and economically inefficient. Regarding economic effectiveness (EE), Its levels varied Farm No. 24's value was the lowest at (0.55) and the highest at (100%), with each farm represented by a quantity of 5%, with an average value of (82%) for all of them, Due to the realities faced by the agriculture sector in Iraq in general and the Hawija district in particular, this level is regarded low when compared to the averages of both technical and allocational effectiveness, in light of the lack of government assistance and the expensive production requirements. The productivity of a single dunam and other factors worked together to contribute to the fall in allocative efficiency, which led to a reduction in economic efficiency.

Table 2: Shows technical, specialized, and financial efficiency in relation to the shift in return on capacity

(EE) economic effectiveness	(AE) allocative effectiveness	(TE) Technical Efficiency	Farm sequence	(EE) economic effectiveness	(AE) allocative effectiveness	(TE) Technical effectiveness	Farm sequence
0.946	0.946	1.000	42	0.749	0.930	0.805	1
0.762	0.958	0.795	43	0.711	0.711	1.000	2
0.706	0.706	1.000	44	0.868	0.958	0.907	3
0.841	0.930	0.904	45	0.876	0.876	1.000	4
0.996	0.996	1.000	46	0.752	0.936	0.803	5
0.745	0.745	1.000	47	0.766	0.766	1.000	6
0.925	0.925	1.000	48	0.846	0.846	1.000	7
0.860	0.965	0.891	49	0.990	0.990	1.000	8
0.723	0.927	0.779	50	0.936	0.936	1.000	9
0.772	0.786	0.982	51	0.723	0.723	1.000	10
0.853	0.853	1.000	52	0.772	0.837	0.922	11
0.963	0.963	1.000	53	0.852	0.906	0.940	12
0.749	0.938	0.798	54	0.961	0.961	1.000	13
0.968	0.968	1.000	56	0.679	0.719	0.944	15
0.697	0.728	0.958	57	0.933	0.937	0.995	16
0.843	0.957	0.881	58	0.805	0.805	1.000	17
0.958	0.958	1.000	59	0.931	0.931	1.000	18
0.949	0.949	1.000	60	0.700	0.851	0.823	19
0.702	0.884	0.794	61	0.701	0.708	0.990	20
0.762	0.782	0.974	62	0.774	0.861	0.898	21
0.837	0.940	0.890	63	0.820	0.820	1.000	22
1.000	1.000	1.000	64	0.720	0.720	1.000	23
0.753	0.831	0.905	65	0.550	0.550	1.000	24
0.950	0.950	1.000	66	0.780	0.869	0.897	25
0.719	0.719	1.000	67	1.000	1.000	1.000	26
0.846	0.846	1.000	68	0.838	0.838	1.000	27
0.721	0.721	1.000	69	0.716	0.716	1.000	28
1.000	1.000	1.000	70	0.868	0.966	0.898	29
0.828	0.869	0.954	Average	0.885	0.885	1.000	30
0.55	0.55	0.779	The lowest value	0.935	0.935	1.000	31
1	1	1	highest value	1.000	1.000	1.000	32
				0.751	0.751	1.000	33
				0.825	0.825	1.000	34
				0.891	0.891	1.000	35
				0.727	0.890	0.817	36
				0.761	0.819	0.929	37
				0.865	0.965	0.897	38
				0.749	0.755	0.992	39
				1.000	1.000	1.000	40
				0.964	0.964	1.000	41

Based on information from the survey, as determined by the Deap data envelope analysis program

CONCLUSIONS

1- The average technical efficiency rate for the yellow corn crop, calculated using the drip irrigation technology and the variables of the production function, was (85%). Achieving the highest level of technical efficiency (100%) required a total of (7) farms, or (23%) of the farms in the sample under study.

2- Four farms were able to attain pricing efficiency (AE) at a level of 100% for the harvest of yellow corn. these farms made up 5% of the total sample under study. This was established by evaluating the technical efficacy based on the cost function's variables and the data envelope program's (DEA) method of analysis.

3- The results of the study showed that the economic efficiency (EE) reached an average of (82%) for the yellow corn crop.

4- We concluded that the absence of receiving and marketing plans caused great damage to farmers, which requires treatments and rescues in support of the local product and the agricultural sector in general.

Recommendations:

1- using the data envelope model's efficiency indicators to generate production functions with constant and variable volume returns for corn crop farms that fell short of a 100% efficiency score.

2- Adopting the expertise of efficient farm owners and benefiting from them in employing their expertise on inefficient farms in order to reach full efficiency levels.

3- In order to understand the issues and challenges farmers face when growing maize and other agricultural crops and how to successfully overcome them, The report advises applying the data envelope analysis (DEA) approach in upcoming investigations. This is due to the fact that it offers thorough findings for every farm and resource used in the production process.

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