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ESTIMATING THE ECONOMIC EFFICIENCY OF THE COMPLEMENTARY IRRIGATION OF WHEAT IN THE PRODUCTION SEASON 2022 NINEVEH GOVERNORATE – TELKIF DISTRICT

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Abstract

The current study aims at estimating the technical efficiency, allocative efficiency and the economic efficiency of wheat crop according to Data Envelopment Analysis (DAE). The researcher used data that is taken from a random sample that involves farmers of wheat in Nineveh governorate – Telkif district for the production season 2022. The sample included (75) farmers who represents 100% of the population in question. The data was obtained via designing a questionnaire form that was prepared for this purpose. The results of efficiency analysis showed according to the data envelopment and depending on the variables of the cost function that the number of the farms that achieved a technical efficiency with a level of 100% is (28) farms and with a percentage of (37%) of the sample farmers. Moreover, the farms that achieved allocative efficiency with a percentage of (100%) were (2) farms, with a percentage of (3%) of the farms included in the sample. Additionally, the farms that achieved an economic efficiency with a percentage of (100%) were (2) farms, with a percentage of (3%) of the farms included in the sample. the researcher would recommend to make use of the efficiency indicators that were obtained from the Data Enveloping Analysis in addition to encourage and direct the farmers to use the modern techniques of irrigation and the necessity to encourage the role played by the extension system in terms of raising the awareness of the farmers by urging them to adopt the modern irrigation methods.

Key Words: economic efficiency, technical efficiency, allocative efficiency, Data envelopment method

Introduction

Wheat is considered one of the important strategic crops as it comes in the first rank amongst the cereals and it contributes mainly as preserving the food security because it is a major food for the human in many countries around the world. The crisis of water shortage in Iraq resulted in a decline in the quantities of wheat produced for the year 2022 compared to the past five years and this led to a great decline in the strategic storage of the country and this made the competent authorities head to import wheat to meet the local need in the midst of the crisis of international provision due to the Russian – Ukrainian war. As the demand on wheat increases because it is a main crop for food, the necessity required to study the obstacles that confront the cultivation of this crop so that the economic efficiency (EE) can be reached, which includes the technical efficiency and the allocated efficiency.

Problem of the search

The problem of the research is represented by the decrease of wheat productivity in spite of the high costs of production and failure in achieving production sizes that are approximate to the optimum sizes and area at which the least production costs are accomplished and a maximum profit.

Objective of the search

This research aims at estimating the technical, allocative and economic costs of wheat according to the Data envelopment analysis (DEA).

Procedure of the search

The research pivoted on two methods in the analysis, the first is descriptive, which rested on the studies that tackled the subject of the study and the second is the quantitative economic analysis that depended on a questionnaire form in a way that is compatible with the concepts and the bases of the economic theory using the statistical package (SPSS 25) to estimate the cost function with the cubic formula using and also using the software Excel to arrange and categorize the data. In analyzing the economic efficiency Data envelopment analysis (DEA) was used.

Resources of the data

The research used a cross-section data that was obtained through the personal interviews with the farmers using a questionnaire form that was prepared by the researcher that targeted a random sample, which included (75) farmers in Telkif district for the production season 2022 and the sample constitutes (100%) of the research population.

Economic Efficiency and Implications

The economic efficiency stands for achieving the optimum case of obtaining the maximum profits through maximizing the profit or minimizing the costs by means of choosing between the multiple uses of the resources and the different production methods (Ga'eed, 2004: 53).

The economic efficiency is accomplished by the interpolation of the following conditions (Abduljawad, 2006: 1-3).

1- The efficient allocation of the economic resources.
2- The investment efficiency.
3- The full use of the economic resources.
4- Achieving the production efficiency.

Methods of estimating the economic efficiency

Measuring the economic efficiency is regarded as one of the most important tools used to measure the extent of success of the economic units as it is a quantitative scale that seek the best usages that connects the inputs and the outputs to achieve its goals in the maximum efficiency and then develop the economy of the country in general. The economic efficiency can be estimated through the traditional and the new methods. The most important traditional methods is the least squares (OLS), but the new methods represents the standard parametric and non-parametric methods and the most vital of these methods and the most commonly used to measure the economic efficiency is the non-marginal (non-parametric), which is known as the data envelopment analysis

(DEA) and a marginal method (parametric) that is called the random margins analysis (Ramadhan, 2012: 14) (Erhabor, 2007).

The following are the most important methods or styles used in estimating the efficiency:

1- The marginal style method.
2- The Duality theory method.
3- The minimum yield increase require (MyIR)
4- The stochastic frontier analysis.
5- The data envelopment analysis method.

The data envelopment analysis method (DEA)

Data envelopment analysis method (DEA), is considered as a tool used by the linear programming to determine the optimum blend of the group of inputs and outputs of administrative units with the same goals depending on the actual performance of these units (Bahirmez, 1996: 31). This method is considered non-parametric that doesn't into consideration the random error in the estimation (Herrero and pascoe, 2002: 1). The concept of (DEA) is pivoted on the paper published by (Farrell) in 1957, but the definition of the term differed as it is translated at the data envelopment (Ba Hermez, 1996) and this concept is dependent on that the any establishment that uses inputs, which are less than other one to produce the same level of production is considered more efficient. According to (DEA), the marginal efficiency curve is formed by finding a virtual production unit that expresses the best collection of observations for the ratio of inputs to outputs and this curve is the one that covers all the observation under the study (AlMohammed et al., 2018: 73).

The concept of complementary irrigation

The complementary irrigation is defined as proving additional quantity of water to a certain plant to promote or to stabilize its production and planting this plant is possible if it depended on the rainwater. The water of the complementary irrigation alone will not be sufficient to make this plant give any yield (AlNuaimi and Shadeed, 2010: 3). In terms of the practical application, the complementary irrigation is defined as completing the shortage that occurs between water consumption by a certain crop and the average rainwater from one hand and determining the critical period and the stage of growth that demands an increase in the number of complementary irrigation to get the highest efficiency of water use and the relationship of productivity with the quantity of surplus water and its time (The Arab Organization of Agricultural Development, 1998: 63). It is also defined as the process of providing the soil with water to make the root zone moist to ensure convenient conditions for the plant growth (AlZaidi, 2008: 12).

Objectives of the complementary irrigation (The Arab Organization of Agricultural Development, 1998: 63)

1- Improving the productivity of the winter crops (rain-dependent crops) and achieving stability for them.
2- Identifying the relationship of the productivity and efficiency with the time of adding the water and the water quantity added.

3- Attenuating the pressure on the groundwater and minimizing the loss of the surface water with seasonal flowing.

4- Increasing the efficiency of the complementary irrigation water that is available.

Results and Discussion

The results of measuring the economic efficiency with its components (the technical efficiency and the allocative efficiency) according to the variables of the cost function.

The total economic efficiency (EE) was estimated with its components of the technical effieciency (TE) and allocative efficiency (AE) according to the variables of the complementary irrigation cost function by using the quantities of resources and prices with the supposition of the change of return of economies.

Table (1): Measuring the technical and allocative efficiencies in the light of the change of the return to economies

Number of farms	Technical efficiency (TE)	Allocative efficiency (AE)	Economic efficiency (EE)	Number of farms	Technical efficiency (TE)	Allocative efficiency (AE)	Economic efficiency (EE)
1	0.988	0.962	0.950	40	0.825	0.912	0.753
2	1.000	0.915	0.915	41	1.000	0.701	0.701
3	1.000	1.000	1.000	42	0.948	0.809	0.768
4	0.898	0.933	0.837	43	1.000	0.678	0.678
5	0.996	0.998	0.993	44	1.000	0.620	0.678
6	0.890	0.405	0.361	45	0.771	0.896	0.620
7	1.000	0.827	0.827	46	0.893	0.896	0.690
8	0.951	0.909	0.865	47	0.810	0.798	0.713
9	0.858	0.409	0.351	48	0.768	0.910	0.737
10	0.879	0.383	0.337	49	0.944	0.916	0.704
11	1.000	1.000	1.000	50	0.835	0.766	0.723
12	0.773	0.402	0.311	51	0.795	0.917	0.729
13	0.796	0.347	0.276	52	0.714	0.907	0.648
14	0.879	0.930	0.817	53	0.810	0.903	0.731
15	0.976	0.962	0.939	54	0.944	0.818	0.772
16	0.951	0.961	0.914	55	1.000	0.894	0.894
17	0.781	0.840	0.657	56	1.000	0.513	0.513
18	1.000	0.916	0.916	57	1.000	0.698	0.698
19	1.000	0.749	0.749	58	0.865	0.894	0.773

Number of farms	Technical efficiency (TE)	Allocative efficiency (AE)	Economic efficiency (EE)	Number of farms	Technical efficiency (TE)	Allocative efficiency (AE)	Economic efficiency (EE)
20	0.733	0.742	0.573	59	1.000	0.640	0.640
21	0.901	0.927	0.835	60	1.000	0.776	0.776
22	0.908	0.935	0.849	61	1.000	0.717	0.717
23	1.000	0.632	0.632	62	1.000	0.911	0.911
24	0.905	0.847	0.767	63	0.910	0.882	0.802
25	0.834	0.876	0.730	64	0.926	0.860	0.797
26	0.844	0.875	0.739	65	1.000	0.778	0.778
27	0.830	0.902	0.749	66	1.000	0.655	0.655
28	0.908	0.906	0.822	67	0.883	0.818	0.722
29	1.000	0.720	0.720	68	1.000	0.655	0.655
30	0.843	0.893	0.753	69	1.000	0.620	0.620
31	1.000	0.937	0.937	70	0.944	0.818	0.772
32	1.000	0.889	0.889	71	1.000	0.894	0.894
33	1.000	0.960	0.960	72	0.910	0.876	0.797
34	0.944	0.775	0.732	73	0.795	0.912	0.725
35	0.849	0.882	0.749	74	1.000	0.660	0.660
36	0.966	0.855	0.826	75	0.832	0.872	0.725
37	0.986	0.892	0.880	Average	0.922	0.808	0.745
38	0.883	0.829	0.732	Minimum value	0.714	0.347	0.276
39	1.000	0.734	0.734	Maximum value	1	1	1

Source: It was calculated by the researcher depending on the questionnaire form according to DEA.

From the results reached and presented in the aforementioned table, it was evident that there are (28) farms, which achieved the optimum technical efficiency (TE) (100%), which is highest value the technical efficiency reached and these farms constituted (37%) of the study sample in this analysis. This means that these farms were able to achieve the maximum production of wheat with a specified number of inputs with the presence of the complementary irrigation method. The lowest technical efficiency was achieved by the farm number (52) which was (0.714%), while the average technical efficiency was (92%). As for the alllocative efficiency (AE), two farms achieved (100%) of the allocative efficiency and they represent (3%) of the total farms of the samples within this analysis. The lowest allocative efficiency was achieved by the farm number (13) which was

(0.347%), while the average allocative efficiency was (81%). From the results of estimation of (TE) and (AE) obtained, the economic efficiency (EE) was calculated from the result of multiplying the estimation results of the components and the percentage of each farm. The farms which achieved economic efficiency (EE) (100%) were two farms, which corresponds a percentage of (3%) of the total number of the farms in the sample in this analysis.

The lowest economic efficiency was achieved by the farm number (13) which was (0.276%), while the average economic efficiency was (74%) and this level is considered low compared to the averages of the technical efficiency and the allocative efficiency. Also, the number of the farms that achieved the best yield with a limited number of inputs were the same farms that achieved a technical and allocative efficiencies at the same time, which work within the borders of the curve of the equal yield and so these farms should keep on producing based on the same methods followed.

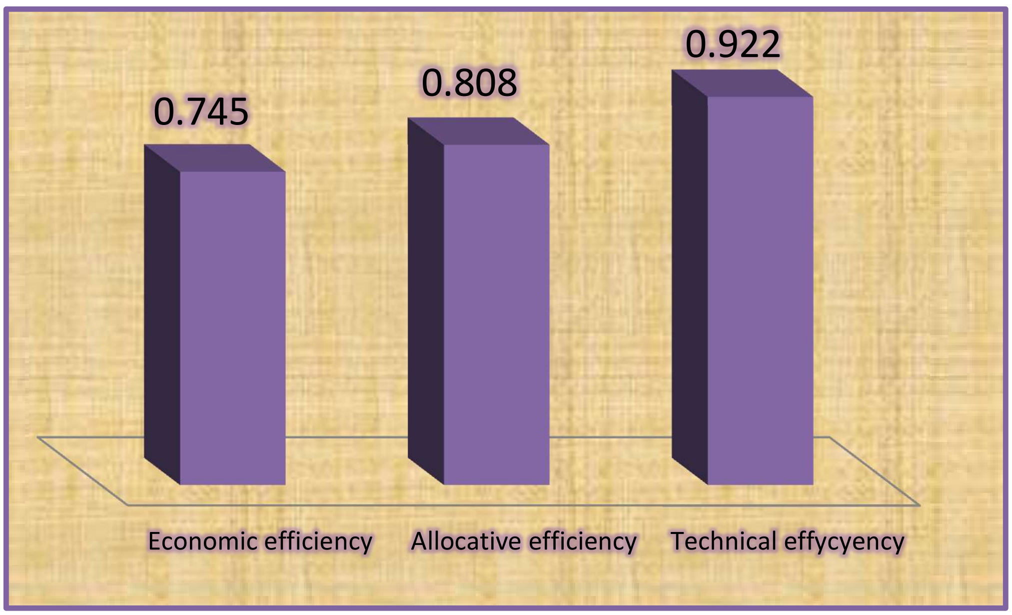

Figure (1): The average technical, allocative and economic efficiencies within the return of economies size (VRS) of wheat in the sample of the study

Source: prepared by the researcher depending on the data in table (1)

Conclusions

The results of the economic efficiency estimation and its components: the technical and allocative efficiencies using the data envelopment analysis (DEA), showed the following:

A- Through estimating the technical efficiency based on DEA and depending on the variables of the cost function, it was clear that the farms that achieved 100% of efficiency are (28) farms and constituted (37%) of the farmers of the research sample.

B- As for the allocative efficiency, the farms that achieved 100% of efficiency are (2) farms and constituted (3%) of the farmers of the research sample.

C- As for the economic efficiency, the farms that achieved 100% of efficiency are (2) farms and constituted (3%) of the farmers of the research sample.

Recommendations

1- The agricultural pricing policies should be activated by the competent authorities by means of providing the authenticated seeds to the farmers with acceptable prices and in early times and also supporting the requirements of the agricultural production by making them available in economic prices and in the suitable time.

2- Making use of the efficient farms owners' experience to apply it in the inefficient farms to achieve the efficiency levels.

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تقدير الكفاءة الاقتصادية للري التكميلي لمحصول القمح للموسم الإنتاجي 2022 محافظة نينوى – قضاء تلكيف

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المستخلص

هدفت الدراسة إلى تقدير الكفاءة التقنية والكفاءة التخصيصية والكفاءة الاقتصادية لمحصول القمح وفق أسلوب تحليل مغلف البيانات Data Envelopment Analysis(DAE).اعتمد البحث على بيانات مستخلصة من عينة عشوائية لمزارعي محصول القمح في محافظة نينوى- قضاء تلكيف للموسم الإنتاجي 2022 وشملت العينة (75) مزارعاً يمثلون 100% من المجتمع موضوع الدراسة، حيث تم الحصول على البيانات من خلال تصميم إستمارة إستبانة أعدت لهذا الغرض. حيث أظهرت نتائج تحليل الكفاءة وفق مغلف البيانات وبالاعتماد على متغيرات دالة التكاليف أن عدد المزارع التي حققت كفاءة فنية بمستوى (100%) هم (28) مزرعة وبنسبة (37%) من مزارعي عينة البحث، أما عدد المزارع التي حققت كفاءة تخصيصية بمستوى (100%) هم (2) مزرعة وبنسبة (3%) من مزارعي عينة البحث، بينما بلغ عدد المزارع التي حققت كفاءة اقتصادية وبنسبة (100%) هم (2) مزرعة وبنسبة (3%) من مزارعي عينة البحث. وعلى ضوء هذه النتائج التي تم التوصل إليها أوصت الدراسة بالإستفادة من مؤشرات الكفاءة التي تم الحصول عليها من خلال أنموذج تحليل مغلف البيانات (DAE)، بالإضافة إلى توجيه المزارعين على استخدام أساليب الري الحديثة، وكذلك ضرورة إعطاء دور للجهاز الإرشادي المزرعي بتثقيف المزارعين وتدريبهم على تبني التقنيات الحديثة في الري.

الكلمات المفتاحية: الكفاءة الاقتصادية، الكفاءة الفنية، الكفاءة التخصيصية، اسلوب تحليل مغلف البيانات.