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ESTIMATION OF TECHNICAL EFFICIENCY LEVELS USING THE DATA ENVELOPE METHOD (DEA) FOR WHEAT CROP CULTIVARS FARMS IN DIYALA GOVERNORATE FOR THE PRODUCTION SEASON (2020-2021)

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Abstract: The aim of the research is to estimate the technical and specialized efficiency and the economic efficiency of wheat crop varieties according to the data envelope analysis method (DEA) and according to the varieties in the research sample, which are (Bura, Adana, Iba 99), and the data was obtained by designing a questionnaire using the random sampling method for farms in the field. Determining the size of the samples for the studied items according to their percentage in the community for (150) farms by (50) farms for each item in the research sample. The results of the efficiency analysis were obtained according to the data envelope for production functions and costs with stability and change in capacity returns. The results of the analysis showed, depending on the variables of the production function, The results showed that the farms that achieved full efficiency (100%) were (11) farms, which were divided into (3) farms for the (Bura) variety, (6) farms for the (Adena) variety, and (2) farms for the (Ibaa 99) variety. These farms can be counted References to the sample farms that did not reach full efficiency, and the number of farms that achieved 100% efficiency in light of the change in yield was (18) farms, divided (6) farms for the (Bura) variety, (8) farms for the (Adena) and (4) farms for the variety (Ibaa 99), respectively, while the number of farms that did not reach 100% efficiency in light of the change in the field Lead (44, 42, 46) farms for varieties (Bura, Adana, Ibaa 99), respectively. Depending on the variables of the cost function, it turns out that the total of the farms that achieved 100% allocative efficiency (6) farms with one farm for the Pura variety and (4) farms for the variety below and one farm for the Ibaa 99 variety. In this case, these farms do not have any surplus inputs because of their consumption of all inputs The optimum size to reach the optimum production, and the results of estimating the economic efficiency of the wheat crop and the studied varieties were also shown, as the average economic efficiency was (0.51, 0.44, 0.41) for varieties (Bura, Aden, Iba 99), respectively, and this level is low, which is the result of the product of each From technical efficiency and allocative efficiency, which shows that these farms can reduce costs by (49%, 56%, 59%) and achieve the same production level, or that these farms can get the current production using (51%, 44%, 41%) of resources to become economically efficient, and in light of the results that have been reached, the research recommended encouraging farmers to use the seeds of modern

varieties with high production to make the best use of agricultural areas in order to give the best production. In addition to benefiting from the efficiency indicators obtained through the data envelope model, and the need to activate the role of the agricultural extension system in alerting farmers to the use of modern agricultural methods in line with the technical progress in this field, especially in the countries of the world.

1. Introduction

According to the opinion of some researchers, Iraq is one of the countries of the original origin of wheat in the world. However, Iraq was and still is considered one of the food deficit countries, as it imports large quantities of wheat annually to fill the deficit in the domestic product. The wheat crop is no longer in the first place among cereal crops only, but has become an important strategic crop in Iraq and the countries of the world as a whole, and it constitutes approximately 50% of the global production of cereals, which includes in addition to wheat, barley, rice, yellow corn, sorghum, millet, oats and rye. Global demand for wheat at an increasing rate of growth as a result of the continuous rise in the population. Low growth in supply exacerbates the problems of the countries of the world, especially the food-deficit countries that suffer from an increasing food gap. If sound agricultural policies are not developed and effective measures are taken to increase the rates of production of grains, their conditions are moving towards The future portends a serious food crisis, and the problem becomes more complex and difficult when we see it from the other side, which indicates that grain-exporting countries such as America, Canada, Australia and others have recently turned to the production of biofuels from grains. The research problem is focused on the low productivity of this important crop, in contrast to the high production costs and the failure to achieve suitable production volumes that are close to the optimal volumes and areas with the lowest production costs and the greatest possible profit, and since Iraq is classified as one of the food deficit countries, because the local production of wheat does not cover The needs of the population, and consequently a large and growing food gap. This requires studying the efficiency levels of wheat crop farms in order to reach the optimum sizes of modern wheat varieties, taking into account the difficulty of horizontal expansion in agriculture due to limited water resources. The aim of the research is to estimate the technical, allocative and economic efficiency according to the variables of the production function and the cost function.

2. Theoretical framework

2.1. Economic Efficiency Concept:

Economic efficiency is one of the terms whose concept overlaps with some other concepts, where efficiency expresses the extent of the success of the economic unit in the provisions of the relationship between the used re-sources and outputs in an efficient manner aimed at maximizing outputs and reducing inputs 1. Efficiency in its precise sense is the study of the relationship between actual and target values of outputs and inputs, while the general concept of efficiency is achieving the greatest level of production at a certain level of technology and available resources. Economic efficiency is defined as the use of sources of wealth in a way that can achieve greater produc-tion 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 achieve the sustainability of scarce resources by ensuring the optimal use of these resources 2.

2.2. types of efficiency

In general, there are many types of efficiency, the most important of which are:

1. **Technical Efficiency (TE)**

It means the ability of the unit to obtain the largest amount of output using the available amounts of inputs. It means the ability of the unit to achieve the greatest output or service using the available set of resources 3. Technical efficiency is the operational state of the production unit compared to the maximum limits of production, as the unit that produces at the level of the maximum limits is technically efficient. The maximum limits of production are the highest levels of production that can be achieved from certain amounts of inputs, and the concept of technical ef-ficiency of the resources used in agricultural production involves avoiding economic loss in the use of these re-sources without obtaining from them the desired satisfaction 4.

2. **Allocative Efficiency (AE):**

The specialized efficiency reflects the ability of the farm to use the crops in optimal proportions according to the prices of these crops and the technology used. It does not only take into account here the efficiency with which the resources are used, but also the efficiency with which the production is distributed, and the specialized efficiency is achieved when the resources are allocated and the optimum size is achieved in order to reach to the well-being of society 5, and it reflects the ability of the production unit to use the optimal mix of inputs, taking into account their prices and available production techniques, ie reflecting the ability to achieve the minimum cost of a certain level of production and thus reflecting the resource combination that maximizes profit when the value of the output is equal Marginal (VMP) for each resource of production with marginal cost (MC) 6, and the allocative efficiency is meas-ured in terms of the line of equal costs, which is based on determining one unit of production using the prices of production factors in the market. We find that The point of tangency between the isoquant curve and the isocost line is only the point at which both technical efficiency and allocative efficiency, i.e. economic efficiency, are achieved.

2.3. Methods to Estimate - Economic Efficiency

Economic efficiency can be estimated through traditional and modern methods, and one of the most important traditional methods for its estimation is the definite marginal statistical method (OLS). Or (non-parametric) known as Data Envelope Analysis (DEA) and parametric method or (parametric) known as random boundary analysis method, and in this study the economic efficiency will be estimated by data envelope analysis (DEA):

2.4. Data Envelope Analysis (DEA):

The method of data envelope analysis or data envelopment analysis is one of the non-parametric methods, thanks to the construction of (DEA) by the scientist Edward Rhodeso in 1978, as he developed building a system (DEA) using it to a system of building multiple inputs and outputs, the location of the boundary efficiency curve is determined by the extreme observations Exterme

7. The concept of (DEA) is based on the article published by Farell in 1975, this concept depends on the simple fact that any facility that uses fewer inputs than others to produce the same level of production is more efficient, and the boundary efficiency curve according to the concept of (DEA) is formed by finding a hypothetical unit of production It expresses the best combination of observations for the ratio of outputs to inputs, and this curve encloses or encloses all observations under study as in Figure (5). 8

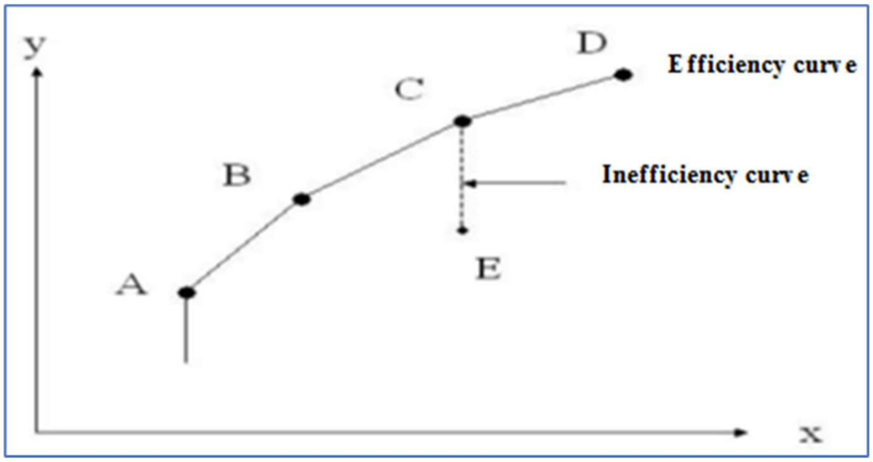

Figure 1. Efficiency curve as per the concept of data envelope, reference: 9

3. Materials and methods of work

3.1. Standard description of the model used to measure economic efficiency and its components according to the variables of the production function.

In order to estimate the technical efficiency of the inputs to the crops of the study sample, as the environmental conditions surrounding the farm make the farmer control his inputs more than his outputs (production), in other words, it is possible to reduce or reduce the cost of inputs more securely than increasing production, and with the presence of field statistical data Represented by (K) of the inputs, which included (amount of seeds/gm), (amount of fertilizers/kg), (amount of pesticides/liter) and (work/hour), which are illustrative variables affecting the dependent factor (M) of total production. For sample farms (N)), and by using the binary theory (Duality) in linear program-ming, the data envelope analysis (DEA) model used to estimate the technical efficiency from the input side in light of the change in capacity returns (VRS) becomes as follows:

$$\text{Min}_{\theta,\lambda}\theta \quad (1)$$

$$y_i + y\lambda \geq 0- \quad (2)$$

$$\theta x_i - X\lambda \geq 0 \quad (3)$$

$$N_i\lambda = 1 \quad (4)$$

$$\lambda \geq 0 \quad (5)$$

where:

Xi: The input vector.
Yi: The output vector.
λ: vector sum.
Ni: expresses the constants and weights associated with efficient farms.
θ: represents the value of the technical proficiency index of farms and lies between (0-1).
The measurement of the efficiency of the SE capacity of the farmer is required while the return to capacity remains constant and variable.

4. Results and discussion

4.1. The results of measuring the economic efficiency and its components by the method of analyzing the data envelope program (DEA) according to the variables of the production function. The results obtained were analyzed and interpreted by estimating and displaying each of the degrees of tech-nical efficiency, volume yield and capacity efficiency according to the production function variables for the wheat crop and for the varieties in the study sample, as shown in the table (31). Which shows the efficiency of capacity and technical efficiency in light of the stability and change of yield of capacity for producers of wheat crop for varieties (Bura, Adana, Iba 99) for (150) farms for the agricultural season (2020-2021) divided into 50 farms according to the items mentioned in the research sample, respectively, and the results indicate Estimation of capacity efficiency and technical efficiency in light of the stability and change of returns for the research sample that the average capacity efficiency amounted to (0.90, 0.94, 0.83) and that this value shows that the sample farmers can increase their pro-duction by (10%, 6%, 17%) for varieties (Bura, below , Iba 99) respectively, using the same amount of resources involved in the production process, and the capacity efficiency ranged between an upper limit of 1 and a minimum of (0.57, 0.61, 0.48) for the varieties of the research sample, respectively. The table shows that the farms that achieved full efficiency (100%) totaled (11) farms, which were divided into (3) farms for the (Bura) variety, (6) farms for the (Adena) variety, and (2) farms for the (Ibaa 99) variety. These farms can be counted References to the viability of the sample farms that have not reached full efficiency and can continue according to the used combination of elements despite their lack of economies of scale and they operate at the optimal size as shown by the volume returns indi-cator. This means that the total production increases by the addition of the same variable production factors. In this case, there is a constant rate of increase in total production, which indicates the fixed percentage of the production elements used in the production process. As for the rest of the sample farms that did not reach full efficiency, they amounted to (47) farms of the (Bura) variety and (44) farms of the (below) variety.) and (48) farms of the (Ibaa) variety, meaning that most of the farms of the (Ibaa 99) variety did not achieve 100% full efficiency compared to the farms of the (Bura and Aden) variety. As for the technical efficiency, which was the basis for calculating the ca-pacity efficiency, the table shows that the technical efficiency in light of the stability of the return The research sample ranged between the highest efficiency of 1 and the lowest efficiency of (0.47, 0.44, 0.33) for varieties (Bura, below, Iba 99), respectively, and its average was (0.70, 0.67, 0.62) for varieties (Bura, below, Iba 99), while the highest technical efficiency was in light of changing returns (1) and for the varieties mentioned in the research sample and the lowest technical efficiency under The yield changes (0.47, 0.45, 0.48) for the wheat varieties (Bura, Adana, Iba) respectively, with an average of (0.78, 0.71, 0.83) and in the same order as the wheat varieties in the research sample. The number of farms that achieved 100% efficiency in light of the change in yield was (18) farms, which were divided into (6) farms for (Bura), (8) farms for (Adena) and (4) farms for (Ibaa 99), respectively. It did not reach 100% efficiency in light of the change in yield (44, 42, 46) farms of varieties (Bura, Adana, Iba 99), re-spectively. And that the reason for this discrepancy in the efficiency ratios from one farm to another is due to the farmers' ability to apply agricultural operations and the experiences they have in managing agricultural lands.

NO	Technical Efficiency (CRS)	Technical Efficiency (VRS)	Scale efficiency SE	Yields volume	NO	Technical Efficiency (CRS)	Technical Efficiency (VRS)	Scale efficiency SE	Yields volume	NO	Technical Efficiency (CRS)	Technical Efficiency (VRS)	Scale efficiency SE	Yields volume
1	0.694	0.964	0.72	irs	31	0.556	0.687	0.809	irs	61	0.5	0.53	0.943	irs
2	0.941	0.981	0.959	irs	32	0.889	1	0.889	irs	62	0.778	0.811	0.959	irs
3	0.913	0.919	0.993	drs	33	0.889	1	0.889	drs	63	0.441	0.472	0.935	irs
4	1	1	1		34	0.69	0.861	0.802	drs	64	0.556	0.561	0.991	irs
5	0.833	0.884	0.943	irs	35	0.833	0.846	0.985	drs	65	0.611	0.615	0.993	drs
6	0.968	0.97	0.998	drs	36	0.944	0.976	0.968	irs	66	0.556	0.575	0.966	irs
7	0.556	0.623	0.892	irs	37	0.746	0.824	0.905	irs	67	0.556	0.577	0.963	irs
8	0.5	0.524	0.953	drs	38	0.574	0.643	0.893	irs	68	1	1	1	
9	0.6	0.632	0.949	irs	39	0.833	0.859	0.97	irs	69	0.556	0.584	0.952	irs
10	0.496	0.525	0.944	irs	40	0.778	0.998	0.779	drs	70	0.5	0.502	0.996	irs
11	0.556	0.97	0.573	irs	41	0.889	0.977	0.91	drs	71	0.667	0.703	0.949	irs
12	0.694	0.845	0.822	irs	42	0.6	0.681	0.881	irs	72	0.586	0.587	0.999	
13	0.474	0.725	0.654	irs	43	0.694	0.718	0.968	irs	73	0.944	1	0.944	irs
14	0.558	0.663	0.841	irs	44	0.944	0.946	0.999	irs	74	0.753	0.962	0.782	irs
15	0.477	0.479	0.997	irs	45	0.833	0.837	0.996	irs	75	0.611	0.634	0.965	irs
16	0.611	0.953	0.641	irs	46	1	1	1		76	0.694	0.732	0.948	irs
17	0.645	0.739	0.872	irs	47	0.556	0.557	0.998	irs	77	0.472	0.491	0.962	irs
18	0.556	0.561	0.991	irs	48	0.589	0.653	0.902	drs	78	0.694	0.723	0.96	irs

19	0.717	1	0.717	drs	49	1	1	1		79	0.556	0.781	0.711	irs
20	0.47	0.48	0.98	irs	50	0.694	0.764	0.909	irs	80	1	1	1	
21	0.472	0.473	0.999	irs	51	0.694	0.743	0.934	irs	81	0.611	1	0.611	irs
22	0.472	0.495	0.955	irs	52	0.609	0.616	0.989	irs	82	0.528	0.558	0.946	irs
23	0.543	0.55	0.988	irs	53	0.556	0.58	0.959	irs	83	0.556	0.587	0.947	irs
24	0.6	0.641	0.936	drs	54	0.5	0.514	0.973	irs	84	0.722	0.739	0.977	irs
25	0.652	0.712	0.916	irs	55	0.612	0.638	0.959	irs	85	0.556	0.558	0.995	irs
26	0.716	0.844	0.849	drs	56	0.556	0.585	0.95	irs	86	0.873	0.995	0.878	irs
27	0.652	0.858	0.76	irs	57	0.694	0.695	1		87	0.639	0.677	0.944	irs
28	0.612	0.626	0.978	irs	58	0.833	0.927	0.899	irs	88	0.694	0.714	0.972	irs
29	0.778	0.805	0.966	drs	59	0.524	0.592	0.886	irs	89	0.778	0.835	0.931	irs
30	0.767	0.806	0.952	irs	60	0.556	0.558	0.997	irs	90	0.889	0.923	0.963	irs

NO	Technical Efficiency (CRS)	Technical Efficiency (VRS)	Scale efficiency SE	Yields volume	NO	Technical Efficiency (CRS)	Technical Efficiency (VRS)	Scale efficiency SE	Yields volume	NO	Technical Efficiency (CRS)	Technical Efficiency (VRS)	Scale efficiency SE	Yields volume
91	1	1	1		111	0.576	0.846	0.681	irs	131	0.5	0.541	0.924	irs
92	0.833	0.848	0.983	irs	112	0.486	1	0.486	irs	132	0.712	0.715	0.996	irs
93	1	1	1		113	0.814	0.941	0.864	irs	133	0.528	0.528	1	
94	0.611	0.62	0.986	irs	114	0.496	1	0.496	irs	134	0.447	0.477	0.937	irs
95	1	1	1		115	0.417	0.514	0.81	irs	135	0.361	0.561	0.643	irs
96	0.944	1	0.944	irs	116	0.389	0.492	0.79	irs	136	0.5	0.566	0.883	irs
97	0.556	0.566	0.982	irs	117	0.333	0.674	0.495	irs	137	0.461	0.501	0.92	irs
98	0.444	0.457	0.974	irs	118	0.417	0.808	0.515	irs	138	0.5	1	0.5	irs
99	0.556	0.565	0.984	irs	119	0.444	0.45	0.988	irs	139	0.761	0.799	0.953	drs
100	0.642	0.667	0.961	irs	120	0.509	0.537	0.947	irs	140	0.472	0.474	0.997	irs
101	0.444	0.55	0.808	drs	121	0.431	0.753	0.572	irs	141	0.417	0.429	0.97	irs
102	0.417	0.74	0.563	irs	122	0.395	0.406	0.974	irs	142	0.474	0.572	0.83	irs
103	0.5	0.538	0.929	drs	123	0.54	0.544	0.991	irs	143	0.417	0.593	0.703	irs
104	0.5	0.541	0.924	irs	124	0.599	0.603	0.994	irs	144	0.468	0.501	0.935	drs

105	0.417	0.573	0.727	irs	125	0.389	0.395	0.985	irs	145	0.462	0.473	0.976	irs
106	1	1	1		126	0.472	0.582	0.811	irs	146	0.422	0.431	0.98	irs
107	0.693	0.703	0.985	irs	127	0.528	0.582	0.908	irs	147	0.417	0.538	0.775	irs
108	0.603	0.604	0.998	irs	128	0.5	0.519	0.964	irs	148	0.5	0.518	0.965	irs
109	0.444	0.562	0.791	irs	129	0.453	0.51	0.889	irs	149	0.472	0.714	0.662	irs
110	0.565	0.633	0.893	irs	130	0.472	0.707	0.668	irs	150	0.444	0.897	0.495	irs
bora cultivar					adina cultivar					ebaa99 cultivar				
	0.701	0.781	0.904	Average		0.672	0.712	0.949	Average		0.5	0.623	0.83	Average
	1	1	1	The lowest value		1	1	1	The lowest value		1	1	1	The lowest value
	0.47	0.473	0.573	highest value		0.441	0.457	0.611	highest value		0.333	0.395	0.486	highest value

Reference: Based on the questionnaire data, according to the Deap Data Envelope Analysis Program

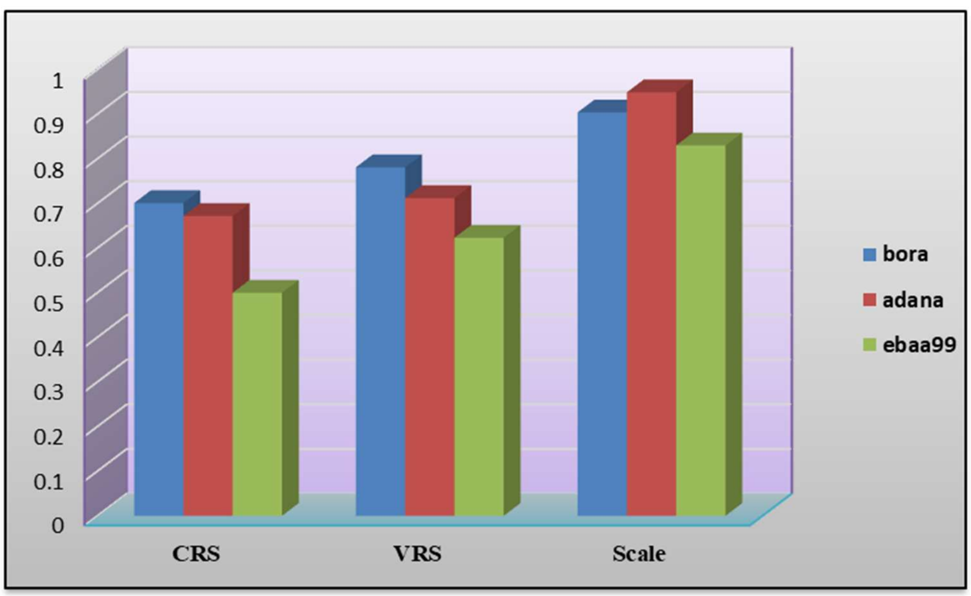

Figure 2. Average technical efficiency with stability and yield change for capacity and capacity efficiency for wheat crop varieties in the research sample, reference: prepared by the researcher based on Table (1).

5. Conclusions and recommendations

5.1. Conclusions

Based on the results that have been reached, the most important conclusions that have been reached can be summarized, including the following:

- By estimating the technical efficiency using the production function of the studied wheat varieties according to the data envelope method, the highest average technical efficiency according to the stability of the yield of capacity was for the Bora variety, followed by the below, and then Ibaa 99
- By estimating the technical efficiency by using the production function of the studied wheat varieties according to the data envelope method, the highest average technical efficiency according to the change of yield to capacity was for the Bora variety, followed by the below, and then Ibaa 99.
- It turned out that the highest capacity efficiency was for the lower cultivar, followed by the Pura cultivar, and then the Iba 99 cultivar.

We conclude from this that these modern varieties have the ability to produce large quantities of the wheat crop, as well as reach high levels of efficiency compared to the old varieties.

5.2. Recommendations

In light of the findings, the research recommends the following:

- Encouraging farmers to use the seeds of modern varieties with high production to make the best use of agricultural areas in order to give the best production.
- Adopting the expertise of the owners of efficient farms and benefiting from them in employing their expertise in inefficient farms in order to reach full efficiency levels.
- It is very important to activate the role of agricultural extension in alerting farmers to the use of modern agricultural methods in line with the technical progress in this field, especially in the countries of the world.
- The research recommends using the Data Envelope Analysis (DEA) method in future research and studies because it provides detailed results for each farm and for each resource used in the production process to know the problems and obstacles facing farmers in producing wheat in its various other varieties and how to reach successful solutions to them.

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