MEASURING THE ECONOMIC EFFICIENCY OF HONEY PRODUCTION IN NINEVEH GOVERNORATE FOR THE SEASON 2018-2019

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Abstract : **This study aimed at identifying the most important factors affecting bee honey production, by performing a comparative study for the economic efficiency and the technical efficiency, data were obtained from field sources in light of a random sample constituted a percentage of 5% taken from honey producers from 51 apiaries at the season of 2018- 2019. The research, in estimating economic efficiency and dividing its components into technical and allocative efficiencies, adopted the data envelopment analysis using the model of entry orientation in light of fixed and variable returns in checking the technical efficiency, and in light of variable capacity return in checking allocative efficiency and cost efficiency, where we note that technical efficiency varied between (0.1-1) with an average of 27%, i.e. the sample is capable of increasing its production by 73% to reach the optimal volume, whereas we note that 96.3% of beekeepers are working with increasing capacity return. The technical efficiency, in light of the variation in capacity return, has varied between 0.5 minimum and 1 maximum with an average of 0.60, and that the apiaries which fell on the possible production curve were 12%. The economic efficiency on the other hand, reached an average of 0.46 and that means the bee breeding farms could achieve the same production level in light of costs reduction of 54%, i.e. capable of producing the current amount using only 46% of the economic resources, and this is attributed to the inadequacy of the allocative efficiency and the improper use of resources. The study recommended the use of amounts that realize the economic efficiency and, the redistribution of resources in a way that guaranties achieving the same level of production or more in light of costs reduction.**

Keywords: **Data envelopment analysis; technical efficiency; allocative efficiency.**

I. Introduction

The increased rates of growth in population and in civilization and awareness levels in medical products and cosmetics increased the demand on these products in general, and on honey in particular, and due to the low level of local production of honey and the lack of knowledge of the extent of production technical efficiency of honey-bee breeders, this created a nutritive gap approached by resorting to import to compensate the deficit in production. However, bridging this gap could be achieved by raising the productivity of this food commodity through making available the requirements of complete exploitation of productive potentials of the farms. Therefore, the influential factors in the production efficiency of beekeepers should be determined and that the production of honey is usually influenced by the level of employing economic resources and their production efficiency, but, due to the rarity of these resources apt for different uses and – as we think- the low level of efficiency in use, it became necessary to study this important activity and to determine the economic efficiency (EE) and its components, being the most important criterion of the economic performance efficiency, then to determine the distance to which the beekeepers are standing from realizing economic efficiency. Beekeeping in Iraq suffers from many problems and obstacles, let alone the inadequacy of breeders in using the economic resources to the level that realizes economic efficiency. The problem of the research is embodied in that beekeepers, like other producers, are far from the optimal exploitation of the economic resources. This study aimed at measuring the efficiency of economic performance of beekeepers in Nineveh governorate for the season 2018-2019 through measuring the economic efficiency with its two folds; the technical and the allocative, as well as determining the amount of resources required to realize economic efficiency and to know the deficit and the surplus in the used economic resources of beekeeping projects.

II. Materials and method

Data Envelopment Analysis Method (DEA) has been used in this research and it is one of the quantitative methods used to rationalize administrative decisions; it is an instrument that uses linear programming to measure technical efficiency through the determination of the optimal combination of inputs, the reason for this name of this method is that economic units of technical efficiency envelop the inefficient economic units, and thus, data of economic units which use inputs less than others are analyzed[1].

Most of the efficiency studies focus on technical efficiency in agricultural activities, and technical efficiency is only one of the components of the total economic efficiency, yet for the farm to be economically active it should be technically active and should reflect the ability of the farmer to obtain the maximum productivity from the set of inputs and the available technology [2]. Allocative efficiency, on the other hand, is the choosing of the combination of inputs which realizes certain amount of production with the least expenses, and it reflects the ability of the farm of the proper use of inputs taking in consideration the prices of these inputs and the available production techniques [3]. Whereas economic efficiency (EE) is a holistic concept of two folds; technical and allocative efficiencies, and the credit of its explanations goes to [4] , he mentioned that there are two approaches to measure and estimate the economic efficiency; the first is to measure it from the input side and this is called (input- oriented measures), and the second from the output side and it is called (output- oriented measures).

There are studies that focused on technical efficiency in case of constant and of variable capacity returns in addition to the efficiency of capacity [5]. The study mainly relied on data collected through a questionnaire, via personal interview for a sample of beekeepers in Nineveh governorate, the research also depended on researches, theses and dissertations and the program of data envelopment analysis was used. Technical efficiency was estimated from the input side and they are called (input- oriented indicators), assuming the existence of variation of capacity return for beekeepers in Nineveh for the season 2018-2019. The model adopted data envelopment analysis which depends on linear programming in its functioning, and two independent variables namely, work/man, for the production season, and the capital in thousand Dinars.

III. Result and Discussion

By employing the data envelopment program dedicated for the research and represented by the production of honey in kg, work in days and capital in ID, then to use the model (DEA) of input orientation of the variable volume returns to calculate the technical efficiency, and the input orientation in light of variable volume returns in calculating both the allocative and the economic efficiencies, and after describing and forming the model, then to state the technical and economic efficiencies and their components and as follows:

First: Capacity efficiency and technical efficiency:

The nature of capacity return for any production unit can be determined through the measurement of capacity efficiency and the reason behind using this approach is that the economics of volume can directly determine the efficient or otherwise inefficient production unit, and to measure the capacity efficiency [6] it is required to measure the technical efficiency in light of constancy and variation of capacity return, i.e. the capacity return of the production unit represents the proportion between technical efficiency of the production unit under conditions of constancy and conditions of variation of capacity return . Looking at the results of technical efficiency in table (1), we find that it varied between 0.1 and 1.0, with an average of 27%, i.e. the sample can increase its productivity by 73% to reach the optimal volume. We also find that only 3% of the breeders in the sample achieved 100% efficiency and they can be considered role- models for the rest of the breeders and they can continue with the current combination. We also note that 96.3% of the breeders work with increasing capacity return, whereas regarding technical efficiency under conditions of capacity return variation, it varied between a minimum of 0.5 and a maximum of 1.0, the average of which was 0.6. The number of apiaries that fell on the possible production curve was of 12% ratio and these apiaries ought to use the same used method in maintaining their resources and productivity.

From the above mentioned we notice a difference between the degrees of technical efficiency obtained in (CRS and VRS) and this can be due to the inefficiency of some apiaries equals to the difference of degree between (CRS and VRS), and that the capacity efficiency was of an average equals (0.42) of which only two apiaries work with constant capacity return, table (1).

Table 1. Technical efficiency in light of variation and constancy of return, capacity efficiency and the yield by volume)

Apiary	Yield	Capacity efficiency	Technical efficiency/Variable return	Technical efficiency/ constant return
1.	irs	0.321	0.63	0.509
2.	irs	0.087	0.848	0.103
3.	irs	0.467	0.709	0.659

4.	irs	0.19	0.587	0.324
5.	irs	0.105	1	0.105
6.	irs	0.056	0.325	0.171
7.	irs	0.261	0.604	0.432
8.	irs	0.034	0.515	0.065
9.	irs	0.021	0.6	0.035
10.	irs	0.143	0.847	0.169
11.	irs	0.147	0.414	0.354
12.	irs	1	1	1
13.	irs	0.2	0.489	0.409
14.	irs	0.097	0.459	0.211
15.	irs	0.117	0.419	0.28
16.	irs	0.457	0.787	0.58
17.	irs	0.322	0.624	0.517
18.	irs	0.172	0.409	0.421
19.	irs	0.313	0.5	0.625
20.	irs	0.108	0.532	0.204
21.	irs	0.171	0.535	0.32
22.	irs	0.415	0.591	0.702
23.	irs	1	1	1
24.	irs	0.07	0.325	0.215
25.	irs	0.089	0.426	0.21
26.	irs	0.102	0.433	0.235
27.	irs	0.391	0.638	0.613
28.	irs	0.463	0.583	0.795
29.	irs	0.214	0.592	0.361
30.	irs	0.584	0.6	0.973
31.	irs	0.554	0.611	0.906
32.	irs	0.468	0.635	0.737
33.	irs	0.227	0.45	0.504
34.	irs	0.305	0.566	0.539
35.	irs	0.104	0.415	0.25
36.	irs	0.265	0.618	0.429
37.	irs	0.056	0.325	0.171
38.	irs	0.344	0.743	0.464
39.	irs	0.371	0.678	0.547
40.	irs	0.410	0.651	0.616
41.	irs	0.556	0.714	0.778
42.	irs	0.114	0.473	0.241
43.	irs	0.207	0.438	0.471
44.	irs	0.062	0.362	0.171
45.	irs	0.554	1	0.554
46.	irs	0.447	1	0.447
47.	irs	0.12	0.703	0.171
48.	irs	0.223	0.492	0.453
49.	irs	0.182	0.416	0.438
50.	irs	0.091	0.375	0.241
51.	irs	0.088	1	0.088
mean		0.271686	0.601686	0.427706

Source: Prepared by the researcher based on the results of (DEA)

Second: Allocative efficiency and economic efficiency of the sample farms

The index of efficiency in this case does not take into consideration the actual resources cost, thus, there is a need to develop a method of analysis of the efficiency of economic resources use that includes the cost of the combination of actual resources of the used economic resources , then it would be possible to compare technical efficiency, which is used once to measure the capacity efficiency, and the other to measure the cost efficiency, with the allocative efficiency which is directly in touch with the production costs in light of the prices of resources and the production cost [7]. Table (2) illustrates that allocatice efficiency varied between (0.7) and (1.0) with an average of (0.73). This result is considered relatively low and it indicates that the redistribution of economic resources will save (27%) of the production cost with maintaining the current production level, i.e. we can increase the production by (27%) without raising the amount of used resources, and this value takes us to the point of tangency between the equal result curve and the line of balance. This low result when compared to the index of technical efficiency has an effect on the reduction of economic efficiency (cost efficiency), whereas, the number of apiaries which achieved 100% allocative efficiency was three and this constitutes 6% of the total sample. Thus, these apiaries have no surplus inputs due to their use of all the inputs to the sufficient extent, i.e. their stagnant values equal (zero). The results also indicated that three farms were technically as well as allocatively efficient, whereas the cost efficiency which is the result of multiplying technical efficiency by allocative efficiency, reached an average of (0.46) and varied between (0.08- 1.0), and this means that honey bees breeding can achieve the same level of production with cost reduction of (54%), which means they are capable of producing the present amount with using only (46%) or less of the economic resources. This low level is attributed to the low allocative efficiency and to not benefiting, according to the concept of capacity economics, from buying the components of production or at the selling of the final product. This was obvious as the production costs used in production increase at the lowest point of the average cost), i.e. beekeepers do not have the ability to choose the optimal resources combination. There are also other factors that explain this reduction, such as the reduction of the product's prices due to its importation and the lack of governmental support as well as the absence of protection of the product in one hand and the reduction of the hive's production compared to the amount of waste in the used resources in production in the other hand.

Table 2. Technical, allocative and economic efficiencies

Apiary	Cost efficiency	Allocative efficiency	Technical efficiency/ Variant capacity return
1.	0.63	0.939	0.592
2.	0.848	0.952	0.807
3.	0.709	0.952	0.675
4.	0.587	0.817	0.48
5.	1	0.805	0.805
6.	0.325	0.514	0.167
7.	0.604	0.821	0.496
8.	0.515	0.734	0.378
9.	0.6	0.39	0.234
10.	0.847	0.884	0.749
11.	0.414	0.573	0.237
12.	1	1	1
13.	0.489	0.722	0.353
14.	0.459	0.706	0.324
15.	0.419	0.702	0.294
16.	0.787	0.45	0.354
17.	0.624	0.7	0.437
18.	0.409	0.517	0.211
19.	0.5	0.801	0.401
20.	0.532	0.602	0.321
21.	0.535	0.707	0.379
22.	0.591	0.9	0.532
23.	1	1	1
24.	0.325	0.675	0.22
25.	0.426	0.793	0.338
26.	0.433	0.737	0.319

27.	0.638	0.934	0.596
28.	0.583	0.927	0.541
29.	0.592	0.43	0.254
30.	0.6	0.991	0.595
31.	0.611	0.953	0.582
32.	0.635	0.743	0.472
33.	0.45	0.736	0.331
34.	0.566	0.817	0.462
35.	0.415	0.684	0.284
36.	0.618	0.893	0.552
37.	0.325	0.378	0.123
38.	0.743	0.85	0.631
39.	0.678	0.903	0.612
40.	0.651	0.982	0.639
41.	0.714	0.353	0.252
42.	0.473	0.228	0.108
43.	0.438	0.797	0.349
44.	0.362	0.226	0.082
45.	1	0.908	0.908
46.	1	1	1
47.	0.703	0.786	0.552
48.	0.492	0.8	0.394
49.	0.416	0.561	0.233
50.	0.375	0.421	0.158
51.	1	0.921	0.921
mean	0.601686	0.737549	0.465373

Source: Prepared by the researcher based on the results of (DEA)

Volume of resources that realize the economic efficiency:

This research adopted calculating the deficit and the surplus in the economic resources used in production when comparing between the amount of resources that realize economic efficiency and the used amount of them, the amount of surplus or deficit in resources= amount of resources at the lowest point of the average cost- the amount of used resources [8]. The ratio of surplus and deficit is calculated by the following formula:

Ratio of surplus or deficit= amount of surplus or shortage in economic resources/ actual amount of use in economic resources

If this difference was positive, then this represents the amount of shortage in resources, whereas if it was negative, then this amount represents the amount of surplus in resources to be provided to achieve optimal use [7].

1. The amount of work required to realize economic efficiency

Most operations and services of the apiary are performed manually, therefore, the actual working days was (4368) days with an average of (85.64) days for each farm. The working days to realize economic efficiency was (4199.9) with an average of (82.3) days for each farm, the surplus of work than that required to realize efficiency was (125.729) with an average of (2.465). The results indicated that the fields showed a deficit of 90.19%, whereas there were four farms, constituting 7.84% of the sample, managed to balance the actual work with that realizing efficiency with no surplus resources. We note that some farms had surplus in labor due to the large size of the family and the spread of actual unemployment in agricultural production. Table (3)

Table 3. amount of surplus and deficit in work resource.

Apiary	Actual work	Work realizing economic efficiency	Deficit & Surplus	Ratio of deficit & surplus
1.	90	71.902	18.098	20.10889
2.	65	70	-5	-7.69231
3.	95	88.6	6.4	6.736842
4.	70	76.6	-6.6	-9.42857
5.	30	70	-40	-133.333
6.	100	74.2	25.8	25.8

7.	65	86.2	-27.2	-32.6154
8.	70	72	0	0
9.	50	70	-20	-40
10.	60	70	-10	-16.6667
11.	90	88.6	1.4	1.555556
12.	100	100	0	0
13.	75	86.8	-11.8	-15.7333
14.	90	70.12	19.88	22.08889
15.	95	74.2	20.8	21.89474
16.	62	100	-38	-61.2903
17.	70	100	-30	-42.8571
18.	100	99.4	0.6	0.6
19.	100	100	0	0
20.	60	72.4	-12.4	-20.6667
21.	75	76.6	-1.6	-2.13333
22.	90	100	-10	-11.1111
23.	100	100	0	0
24.	100	74.2	25.8	25.8
25.	90	70.6	19.4	21.55556
26.	90	71.8	18.2	20.22222
27.	100	87.4	12.6	12.6
28.	105	100	5	5
29.	65	92.2	-27.2	-41.8462
30.	150	100	50	33.33333
31.	120	100	20	16.66667
32.	95	100	-5	-5.26316
33.	95	92.2	2.8	2.947368
34.	100	86.2	13.8	13.8
35.	90	73	17	18.88889
36.	90	77.8	12.2	13.55556
37.	100	74.2	25.8	25.8
38.	75	80.2	-5.2	-6.93333
39.	85	86.2	-1.2	-1.41176
40.	112	78.04	33.96	30.32143
41.	90	100	-10	-11.1111
42.	73	80.20	-7.2	-9.86301
43.	97	88.6	8.4	8.659794
44.	90	74.2	15.8	17.55556
45.	90	70.6	19.4	21.55556
46.	70	70	0	0
47.	60	70	-10	-16.6667
48.	97	83.8	13.2	13.60825
49.	100	105	5	5
50.	92	80.2	11.8	12.82609
51.	45	70	-25	-55.5556
mean	85.64	82.3	2.465	

Source: Prepared by the researcher based on the results of (DEA)

2.   Amount of capital required to realize economic efficiency:

Throughout comparison between the actually used capital in the sample and that realizing economic efficiency, we see that the capital reached (87.063) with an average of (1.707) and accordingly the amount realizing economic efficiency reached (85.063) with an average of (1.667). Also the surplus of capital was (233.850) with an average of (4.585) thousand

ID. We also notice that all the farms of the sample achieved a surplus except three which could balance between the actual capital and that realizing efficiency with no capital surplus (Table 4).

Table 4. amount of surplus and deficit in the resource of capital

Apiary	Actual capital	Capital realizing efficiency	Amount of Deficit or surplus	Ratio of deficit or surplus
1.	2970	1332.17	1637.83	0.55
2.	1292	713	579	0.45
3.	2500	122.9.46	1270.54	0.51
4.	3547	896.26	2650.74	0.75
5.	1955	713	1242	0.64
6.	11410	829.62	10580.38	0.93
7.	4383	1162.82	3220.18	0.73
8.	3325	713	2612	0.79
9.	7710	713	6997	0.91
10.	1476	713	763	0.52
11.	8717	1229.46	7487.54	0.86
12.	1546	1546	0	0.00
13.	5897	1179.48	4717.52	0.80
14.	3795	716.332	3078.668	0.81
15.	4792	829.62	3962.38	0.83
16.	10981	2719.02	8261.98	0.75
17.	6847	1937.007	4909.993	0.72
18.	11871	1529.34	10341.66	0.87
19.	10039	2899.485	7139.515	0.71
20.	4506	779.64	3726.36	0.83
21.	3958	896.26	3061.74	0.77
22.	6503	2478.401	4024.599	0.62
23.	10479	10479	0	0.00
24.	8232	829.62	7402.38	0.90
25.	4392	729.66	3662.34	0.83
26.	4412	762.98	3649.02	0.83
27.	2879	1196.14	1682.86	0.58
28.	8739	3861.963	4877.037	0.56
29.	9687	1329.42	8357.58	0.86
30.	11009	6388.468	4620.532	0.42
31.	11798	6418.545	5379.455	0.46
32.	11220	4463.512	6756.488	0.60
33.	6302	1329.42	4972.58	0.79
34.	3595	1162.82	2432.18	0.68
35.	4895	796.3	4098.7	0.84
36.	2637	929.58	1707.42	0.65
37.	13026	829.62	12196.38	0.94
38.	2359	996.22	1362.78	0.58
39.	2946	1162.82	1783.18	0.61
40.	1615	936.244	678.756	0.42
41.	25823	5065.061	20757.939	0.80
42.	21812	996.22	20815.78	0.95
43.	6066	1229.46	4836.54	0.80
44.	20391	829.62	19561.38	0.96
45.	620	729.66	-109.66	-0.18
46.	713	713	0	0.00
47.	2291	713	1578	0.69

48.	4522	1096.18	3425.82	0.76
49.	13129	1624.201	11504.799	0.88
50.	12533	996.22	11536.78	0.92
51.	1355	713	642	0.47
Mean	1.707	1.667	4.585	

Source: Prepared by the researcher based on the results of (DEA)

Conclusion

1. From what was mentioned, the research concluded that the beekeepers did not use scientific methods in managing their resources, the thing that made them lose the opportunity of higher production, and that their current production can be achieved using (60%) of the resources and that posed an extra cost of 27%.
2. The research also concluded that among the reasons of decline in efficiency is the waste in the used economic resources in producing honey.

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