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Economic and Administrative Efficiency of Fish Enterprises in Fayoum, Egypt

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Abstract **Original Research Article**

This paper aims at estimating the economic and administrative efficiency of fish hatcheries and farms in fayoum governorate. Data envelopment analysis approach & stepwise regression are used to estimate the economic efficiency and descriptive statistics is used to measure the administrative efficiency. To achieve the research objective, a random sample was selected and data collected using pre-designed questionnaire for this purpose through one-on-one interviews. Fish farms owned by companies are found to be more economic efficient than those owned by individuals although they did not achieve the full efficiency. Hormones and management are shown to be of significant impact on production and renewal period of broodstock, protein percentage in fry fodders and fry temperature are of significant impact on profits of fish farms. Catfish and mix farms are the most efficient in individually-owned farms. On the other side, gilt-head bream & bass farms are the most efficient in companies-owned farms. The fish hatcheries are shown to be administrative efficient as they are owned and run by specialized companies. In fish farms; the management efficiency in the farms owned and run by companies are more than in those owned by individuals due to professionality. The gilt-head bream & bass and tilapia & mullet farms owned by companies are shown to be the most efficient production pattern.

Keywords: Administrative Efficiency, Management Functions, Economic Efficiency, Fish Farms, Fish Hatcheries, Fayoum, Egypt.

INTRODUCTION

Project management is an effective tool to improve the management functions in any project. It's also extended to the optimal utilization of the project resources and capabilities in order to achieve the objectives of the organization efficiently and effectively. Therefore; project management includes all means and methods used in running projects and achieving their objectives. The management functions are; planning, organizing, directing and evaluating. The four functions explained by [1] as follows; planning requires looking at the past, present and future and is a philosophy or method of systematic thinking that helps the manager anticipate and prepare future issues in advance according to internal and external factors in the project, organizing is a tool to achieve administrative coordination and flow of work and information to help perform the right work and thus achieve the desired goals efficiently and effectively, directing means measuring and evaluating the actual performance against pre-determined objectives and take appropriate actions if necessary and evaluating is intended to assess units of production to judge the success of the farm and the efficiency of production units and management.

By studying the management in fish farming projects as one of the most important agricultural projects and an important pillar of fisheries, it's found that fish farming has achieved a significant increase in fish production in recent years as a result of policies encouraging and stimulating investment in this field. Fish farming constitutes for 46.8% of the world fish production in 2016 compared to 25.7% in 2000 [2]. In Egypt, according to CAPMAS [3], the total fish production increased from 13 thousand tons in 2010 to 17.1 thousand tons in 2016 with 31.5% total increase. The share of fish farming to the total fish production in Egypt has increased over years. Figure 1 shows that the share of fish farming into the total fish production has increased from 70.5% in 2010 to 80.5% in 2016.

However, there have been many variables that may affect the continued growth rates in this sector where a large

portion of the fish farms depend on agricultural drainage water and the quantities available are decreasing as a result of the water policy of the Ministry of Irrigation that based on the reuse of agricultural drainage water for agricultural purposes [4]. Therefore, the fish farming area has decreased from 360 thousand feddans in 2010 to 320 thousand tons in 2016 [3]. This policy will affect the area of fish farms that depend on agricultural drainage water.

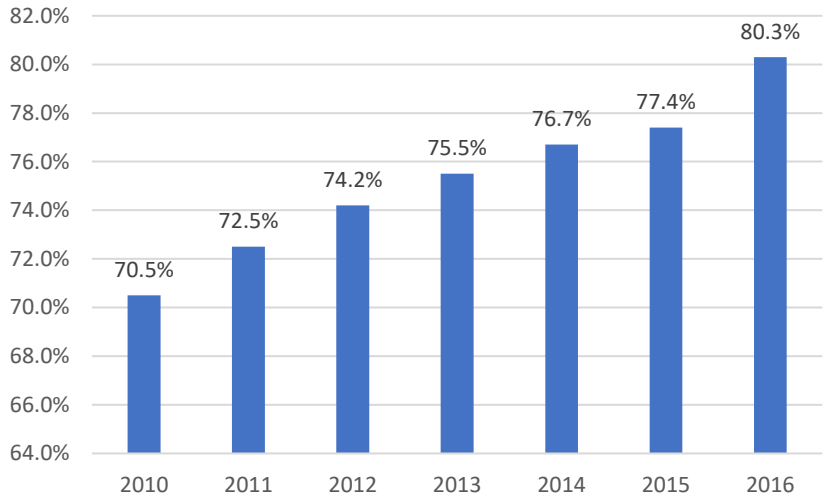

Fig-1: The share of fish farming in the total fish production in Egypt 2010-2016
Source: CAPMAS, Annual Bulletin of Fish Production Statistics, 2017

DATA AND METHODOLOGY

Although the fish farming is increasing and its share in the total fish production is increasing, however, the farms are faced by several challenges including low economic efficiency in using some of the inputs and low management capabilities. Accordingly, the efficient management can significantly impact the total farms' efficiency. Therefore, this paper aims to investigate the economic and administrative of fish hatcheries and farms in Fayoum Governorate. In details; the paper estimates the economic efficiency of farms and the factors affecting the production and profit of both hatcheries and farms, it also evaluates the performance of the management functions.

Data were collected using a pre-designed questionnaire through one-on-one interviews with managers of fish hatcheries and farms in Fayoum during the year 2015/2016. All 10 hatcheries are surveyed and a random sample of 110 farms representing 52% of the total number of farms and 43% of the total area are selected. Descriptive and quantitative analysis are used to measure the achievement of the objectives. Stepwise regression is used to determine the factors affecting production and profit of hatcheries, Data Envelopment Analysis approach is used to measure economic efficiency of the fish farms, and descriptive statistics is used to evaluate administrative efficiency.

RESULTS AND DISCUSSION

Economic Efficiency (Cost Efficiency)

Throughout this section; the economic efficiency of fish farms is measured using Data Envelopment Analysis DEA. It is worth mentioning that the economic efficiency of fish hatcheries has not been measured using DEA due to the lack of economic alternatives, since the only mode of production is the production of tilapia. Alternatively, stepwise regression is used to determine the important factors affecting the production and profit of hatcheries.

Economic efficiency of fish farms

Data Envelopment Analysis (DEA) is a relatively new "data oriented" approach for evaluating the performance of a set of peer entities called Decision Making Units (DMUs) which convert multiple inputs into multiple outputs and, in recent years, it was used in evaluating the performances of many different kinds of entities engaged in many different activities in many different contexts in many different countries including business firms [5]. The initial CCR DEA model has been conducted using the data collected from the sample farms using the DEAFrontier software for the different farms' types either they are individually-owned or companies-owned.

The fish farms surveyed are categorized in two main categories; individually-owned and companies-owned farms. Several production patterns included in each category. The individually-owned farms include the following patterns; catfish, tilapia, tilapia & mullet and mix farms. The companies-owned farms include the following patterns; ornamental, tilapia & mullet, gilt-head bream & bass and mix farms.

Analysis has been conducted for the four production patterns in each category. The following cost variables are used; fodder, fry, management and permanent labor. Table 1 shows the efficiency coefficient for the surveyed farms. The coefficient ranges from zero to one. The farm is totally efficient when the coefficient equals to 1 and totally in-efficient when the coefficient equals to zero.

Table-1: Economic efficiency of variable costs in fish farms in Fayoum during 2015-2016

Farm Type		Fodder	Fry	Management	Labor
Individually-owned	Catfish	1.00	1.00	1.00	1.00
	Tilapia	0.18	0.01	0.96	.030
	Tilapia & Mullet	0.07	0.37	0.61	0.25
	Mix	1.00	1.00	1.00	1.00
Companies-owned	Ornamental	1.00	0.65	1.00	1.00
	Tilapia + Mullet	0.94	1.00	0.97	0.64
	Gilt-head bream & Bass	1.00	1.00	1.00	1.00
	Mix	0.97	0.51	0.97	0.85

Source: calculated from survey data.

As for the individually-owned farms; the catfish and mix farms are achieving full efficiency and the inputs are fully utilized where the tilapia and tilapia & mullet farms are not performing efficiently and need to utilize the four inputs investigated in a more efficient way. As for the companies-owned farms; the ornamental farms are fully efficient except in the use of fry as they are required to efficiently utilize the use of fry while the gilt-head bream & bass farms are fully efficient. The tilapia & mullet farms are highly efficient in utilizing the inputs except the labor use and the mix farms are somehow performing efficiently except for the use of fry.

Factors affecting production and profit of fish hatcheries

The stepwise model has been developed for determining the main factors affecting the production of fish hatcheries surveyed during the year 2015/2016. The model is built using the quantity of fry (in million units) as a dependent variable and a set of independent variables namely; rent, management, wages, broodstock fish, number of males, broodstock's fodder, fry fodder, hormones, fuel and electricity (in EGP). It's found that hormones and management are the factors significantly affect fry production according to the dual logarithmic function. The model is shown to be significant at 1% significance level where the F value is 37.6. The adjusted R^2 is found to be 0.89 which means 89% of the changes in fry production belong to changes of both factors. Both factors are shown to be of significant impact at 1% significance level. The coefficients of both factors are shown to be 0.68 and 0.28 which means an increase of 1% in both factors results in an increase of production of fry by 68% and 28% respectively. The overall elasticity of the variables entered in the model is 0.955, which reflects a decreasing return to scale. Equation (1) represents the model.

$$Ln\hat{Y}_i = -6.88 + 0.68LnX_{hi} + 0.28LnX_{mi} \quad (1)$$

Where

$\hat{Y}_i$: estimated value of hatcheries 'production of fish (in million units)

X_{hi} : value of hormones' cost (in EGP) and X_{mi} : value of management's cost (in EGP)

As for the factors affecting the hatcheries profit; a stepwise model has been developed for determining the main factors affecting the profit of fish hatcheries surveyed. The model is built using the average profit of hatcheries (in EGP) as a dependent variable and a set of independent variables namely; renewal period of broodstock and males, protein percentage in fry fodders, fry temperature and the percentage of production losses. It's found that renewal period of broodstock, protein percentage in fry fodders and fry temperature are the factors significantly affect fry profit of hatcheries according to the linear function. The model is shown to be significant at 1% significance level where the F value is 25.75. The adjusted R2 is found to be 0.89 which means 89% of the changes in hatcheries' profits belong to changes of the three factors. All three factors are shown to be of significant impact at 1% significance level. Equation (2) represents the model.

$$\hat{Y}_i = -160477 + 36963X_{bi} + 1675X_{pi} + 8897X_{ti} \quad (2)$$

Where

$\hat{Y}_i$: average profit of hatcheries (in EGP) X_{bi} : renewal period of broodstock

X_{pi} : protein percentage in fodder X_{ti} : fry temperature

Administrative Efficiency

For the purpose of estimating effectiveness of the management functions in fish hatcheries and farms; a selective set of indicators [6] are used in the form of questions including yes or no questions and multi-level answers for each function. Answers are valued and the values are accumulated resulting in a minimum and a maximum level of effectiveness for each function. The minimum and maximum levels are set to be; (9, 35), (6, 22), 2, 13) and (1, 6) for the four functions respectively. Minimum and maximum levels vary depending on the number of activities under each function. The performance of the management functions reflects the extent to which the projects are aware of the productive, financial, economic and marketing aspects and the smooth integration of these functions to achieve the objectives of the project. Estimates for the degree of effectiveness of each function and the total effectiveness are calculated. The technical and economic factors affecting the production are also analyzed.

Effectiveness of performing management functions in fish hatcheries

Fish hatcheries are the main foundation on which fish farming is based. Throughout this section; the performance of management in hatcheries in Fayoum Governorate are highlighted.

Figure 2 shows the performance of the management functions in the fish hatcheries during the year 2015/2016. The average level of performance of the planning function was 24.8 degrees with a minimum of 22 and a maximum of 29 degrees and a standard deviation of 2. The average performance of the organizing function was 10.3 degrees with a minimum of 7 degrees and a maximum of 15 degrees and a standard deviation of 2.3 degrees. The average performance of the directing function was 8.5 degrees with a minimum of 7 degrees and a maximum of 10 degrees and a standard deviation The average performance of the evaluation function was 3.8, with a minimum of 1, a maximum of 6, a standard deviation of 1.54, The level of performance of the total administrative functions was 47.4 degrees with a minimum of 39 degrees and a maximum of 60 degrees and a standard deviation of 6.36 degrees.

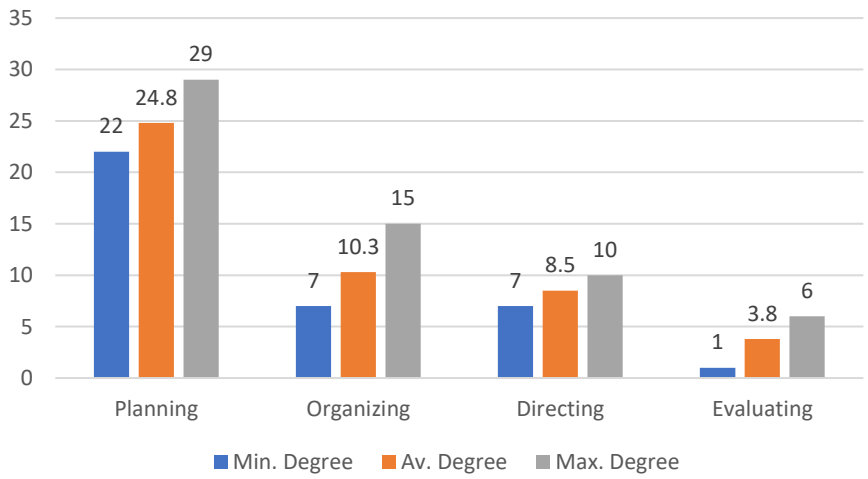

Fig-2: The degree of performing management functions in fish hatcheries in Fayoum 2015-2016

Source: calculated from survey data.

Effectiveness of performing management functions in fish farms

The management efficiency for each of the production patterns in each category has been measured. Table 2 shows the performance of the management functions in the individually-owned fish farms and table 3 shows the performance of the management functions in the companies-owned fish farms.

Table-2: The performance of the management functions in the individually-owned fish farms

Function	Min. Level	Max. Level	Catfish	Tilapia	Tilapia & Mullet	Mix
Planning	9	35	19.1	17.2	18.3	20.6
Organizing	6	22	8.5	8.9	9.7	9.9
Directing	2	13	37.1	7.6	7.1	6.6
Evaluating	1	6	1.8	2.4	2.5	2.4
Overall	19	76	39.4	36.2	37.6	39.4
%	25	100	48	49.5	49.5	51.8

Source: calculated from survey data.

As for farms owned by individuals; the average levels of performance of the planning function are shown to be; 19, 17, 18 and 21 for the four patterns respectively. The average levels of performance of the organizing function are shown to be; 9, 9, 10 and 10 respectively. The average levels of performance of the directing function are shown to be; 37, 8, 7 and 7 respectively. The average levels of performance of the evaluation function are shown to be; 2, 2, 3 and 2 respectively. The levels of performance of the total administrative functions are shown to be; 48, 48, 49 and 51 respectively. The percentage of the overall performance is shown to be 48% to 51.8%.

As for farms owned by companies; the average levels of performance of the planning function are shown to be; 23, 28, 32 and 21 for the four patterns respectively. The average levels of performance of the organizing function are shown to be; 11, 20, 20 and 16 respectively. The average levels of performance of the follow-up function are shown to be; 8, 11, 12 and 49 respectively. The average levels of performance of the evaluation function are shown to be; 2, 5, 5 and 4 respectively. The levels of performance of the total administrative functions are shown to be; 81, 63, 58 and 91 respectively. The percentage of the overall performance is shown to be 57.9% to 90.9%.

Table-3: The performance of the management functions in the companies-owned fish farms

Function	Min. Level	Max. Level	Ornamental	Tilapia & Mullet	Gilt-head bream & Bass	Mix
Planning	9	35	23	28.5	32	21
Organizing	6	22	11	20	20	15.7
Directing	2	13	8	11.4	12	47.8
Evaluating	1	6	2	4.9	5	3.7
Overall	19	76	44	61.6	69	48.2
%	25	100	57.9	81.1	90.9	63.4

Source: calculated from survey data.

In general; the management efficiency in the farms owned and run by companies are more efficient than those owned by individuals. The gilt-head bream & bass and tilapia & mullet farms owned by companies are the most efficient pattern. These results are in accordance with [7].

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