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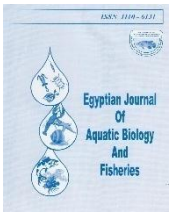

Factors affecting aquaculture farms' profitability and constraints facing fish farmers in Egypt

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ABSTRACT

To determine the constraints facing fish farmers and affecting the profitability of aquaculture farms, this study was conducted in different regions of Egypt. The data were collected by using a semi-structured interview with a questionnaire. Data were statistically analyzed using SAS procedure. The descriptive data were tested by the chi-square procedure. Fish culture's production performance was determined based on the benefit-cost ratio (BCR). The log-linear regression model was used to determine and quantify the relations between all the independent variables and the BCR (dependent variable). The results demonstrated that about three-quarters of the respondents sold their fish production at the farm gate. More than 55% of the farmers had medium farm sizes (10-20 feddan), and polyculture was the prevailing culture type for 76% of them. The semi-intensive system (4-5 fries/m^3 water) was the culture system for more than 94% of the respondents. The BCR for 85% of the selected fish farms ranged from 1.46 to 2.50. There were many problems facing the fish culture farmers. The most severe problems were the high feed price, lack of operating capital, high energy price, high fry price, lack of credit support, management problems, labor irregularity, vaccine unavailability, and the high price of vaccination and medication. The high mortality rate was a severe problem for half of the respondents. More than 71% of the respondents found there was no problem with the lack of marketing information. The study concluded that fish culture farmers in Egypt are facing many problems which affect their profitability. Using alternative feedstuff may become a possible solution to reduce the feed's prices. Developing the existing fish hatcheries and increasing the number of hatcheries will lead to reducing the fry prices. Instantaneous actions are needed to achieve efficient production and economic returns.

INTRODUCTION

Fish consider a cheap source of animal protein. The demand for fish is increasing continuously with the population increasing. The contribution of fish to the total human consumption of animal protein was about 24% **(FAO, 2020)**. Over the past two decades, aquaculture in the world has developed tremendously and has become an economically important industry **(FAO, 2008)**. Nowadays more than 50% of the consumed fish in the world is coming from farmed fish **(Subasinghe *et al.*, 2009** and **FAO, 2020)**. Millions of people in developing countries depend on aquaculture for food and livelihoods **(Dighiesh, 2014** and **Wally, 2016)**. Aquaculture production represents 73.8% of the total fish production in Africa **(Feidi, 2018)**.

Egypt is the seventh-largest aquaculture country in the world and the largest in Africa. Fish aquaculture farms consider the main source of the Egyptian fish production, which

represents about 77.9% **(MALR, 2018)**. Fish production represented 9.6% of the total Egyptian agricultural GDP. Old agricultural areas represented 97% of fish production, while the remained (3%) is from new agricultural areas. Aquaculture is an effective solution to reduce the gap between fish production and demand in Egypt. Despite the economic importance of aquaculture, some fish farmers have abandoned it due to some challenges that make the project unprofitable.

Thus, the present study was conducted to determine the factors that influence the profitability of fish farming in Egypt. Also, to rank the constraints facing fish farmers and set some possible solutions for it.

MATERIALS AND METHODS

1. Study areas

This study was conducted from January to December 2020. One hundred and ten individual fish farmers were chosen within the studied areas. Studied areas represented different regions of Egypt as follows: 70 farms represented Delta region; Kafr el-Sheikh Governorate (34 farms), El-Beheira Governorate (26 farms), and Ismailia Governorate (10 farms). Twenty farms in both El-Monufia (El Sadat City) represented New Land and El-Faiyum Governorate (Upper Egypt).

2. Data collection

Through a semi-structured interview with a questionnaire, the data were collected from fish culture farmers. The questionnaire includes some personal questions about fish culture farmers like gender, age, years of experience, and education level. Also, questions about fish culture include farm size, activity type, culture type, culture system, labor type (fixed or fishing), access to training, availability of the vaccine, vaccine quality, membership in a co-operative group, access to credit, market information, the marketing channels, mortality rate, and some economical parameters.

3. Statistical analysis

Data were analyzed using **(SAS, 2012)**. The descriptive data were tested by the chi-square procedure **(Snedecor and Cochran, 1993)**. The log-linear regression model was used to determine and quantify the relations between all the independent variables (the farmer's age, experience years, education level, the marketing channels, market information, membership in a co-operative group, access to training, access to credit, farm size, culture type, activity type, culture system, labor cost, fry price, feed cost, transportation cost, total cost, fish selling price, total income, mortality rate, and benefit-cost ratio (the dependent variable).

The log-linear regression model is a transformed model, and assumed that there was a linear relationship between the log dependent variable and log explanatory variable. This transformation into logs allows estimation by a traditional procedure, where In Y_i is a linear function of logs of regression (X's; **Gujarati, 2003** and **Greene, 2008)**. The regression model takes the log specification because not all the explanatory variables (X_i) are linearly related to the value of output (Y_i), and parameters estimates can be interpreted as elasticity. It takes the form of a flexible Cobb Douglas production function. The log-linear regression model used in this analysis was:

$$\mathbf{InY_i=\alpha+\beta_1InX_1+\beta_2InX_2+\beta_3InX_3+\beta_4InX_4+\beta_5InX_5+\beta_6InX_6+\beta_7InX_7+\beta_8InX_8+\beta_9InX_9+\beta_{10}InX_{10}+\beta_{11}InX_{11}+\beta_{12}InX_{12}+\beta_{13}InX_{13}+\beta_{14}InX_{14}+\beta_{15}InX_{15}+\beta_{16}InX_{16}+\beta_{17}InX_{17}+\beta_{18}InX_{18}+\beta_{19}InX_{19}+\beta_{20}InX_{20}+\varepsilon}$$

Where, α= intercept term, Y= value of output computed of the value of profitability (BCR), X_1= farmer's age (years), X_2= experience (years), X_3= education (years), X_4= marketing channels (1 farm gate, 2 middlemen or agents), X_5= market information (1 yes, 2 no), X_6= membership in a co-operative group (1 yes, 2 no), X_7= access to training (1 access, 2 no access), X_8= access to credit (1 access, 2 no access), X_9= farm size (feddan), X_{10}= culture type (1 monoculture, 2 polyculture), X_{11}= activity type (1 culture only, 2 mixed), X_{12}= culture system (1 extensive, 2 semi-intensive, 3 intensive), X_{13}= labor cost (L.E), X_{14}= fry price (L.E), X_{15}= feed cost (L.E), X_{16}= transportation cost (L.E), X_{17}= total cost (L.E), X_{18}= fish selling price (L.E), X_{19}= total income (L.E), X_{20}= mortality rate (%), β_i= coefficients of the explanatory variable, In= natural logarithm and ε= error term (ε independently, normally distributed with zero mean and constant variance.

Fish culture farm's performance was determined based on the benefit-cost ratio (BCR). The BCR is classified into high, medium, and low performance. It was measured using the following formula:

BCR = benefit/cost (**Gittinger, 1982)**.

The problems faced by fish culture farmers were classified as severe, moderate, little, and no problem; with scores 3, 2, 1, and 0, respectively. The impacts of these problems were determined using the problem faced index (PFI) proposed as follows:

Problem Faced Index (**PFI)= 3×FS + 2×FM + 1×FL + 0×FN (Ali and Hossain, 2010)**

Where:

FS = number of farmers faced a severe problem,

FM = number of farmers faced a moderate problem,

FL = number of farmers faced a little problem and

FN = number of farmers faced no problem.

RESULTS AND DISCUSSION

1. Socio-economic characteristics and institutional support of respondent farmers

Data in **Table (1)** demonstrates that all fish farmers in the studied areas were males. This result was different from what was found by **(Njagi *et al.*, 2013)** in Kenya, who noted that 72.7 of the respondents were males. This may be an indicator that the men completely control the units of fish ownership because the nature of the work in fish farms in Egypt is very hard for women, and does not agree with the Egyptian custom. More than half of the respondents were between 31 and 50 years old. About three-quarters of the fish farmers had experience in fish breeding equal to or more than 21 years.

Table (1). Distribution of the respondents based on socio-economic characteristics and institutional support.

Variable	Category	N	(%)	LSM	p-[2] *
Farmer's gender	Males	110	100	-	-
	Females	0	0		
Farmer's age (Years)	Class 1 (≤ 30 years)	6	5.44		
	Class 2 (31-50 years)	64	58.20	49.01	***
	Class 3 (≥ 51 years)	40	36.36		
Experience (Years)	Low (≤5)	7	6.36		
	Medium (6-20)	21	19.09	23.18	**
	High (≥21)	82	74.55		
Farmer's Education	Illiteracy (0)	17	15.46		
(Years in school)	Read and write (1-8)	13	11.82	9.78	***
	Intermediate (9-11)	51	46.36		
	High education (≥ 12)	29	26.36		
Farm ownership	Owned	93	84.55	-	**
	Rented	17	15.45		
Labor type					
Fixed labor	Fixed (1-2)	88	80	2.00	***
	Fixed (3-5)	22	20		
Fishing labor	Fishing (< 10)	8	7.27		
	Fishing (10-15)	100	90.91	10.44	**
	Fishing (≥ 20)	2	1.82		
Access to training (Informal)	Yes	20	18.18	-	**
	No	90	81.82		
Access to credit	Yes	22	20	-	**
	No	88	80		
Membership in a co-operative group	Yes	17	15.45	-	***
	No	93	84.55		
Access to market information	Yes	34	30.90	-	**
	No	76	69.10		
Marketing channels	Farm gate	82	74.55	-	**
	Middlemen or agents	28	25.45		
Farm size (feddan)	Small (1-10 feddan)	41	37.27		
	Medium (10-20 feddan)	61	55.46	32.67	**
	Large (≥ 20 feddan)	8	7.27		
Culture type	Monoculture	26	23.64	-	**
	Polyculture	84	76.36		
Activity type	Culture only	98	89.10	-	**
	Mixed (culture and hatchers)	12	10.90		
Culture System	Extensive (2 fries)	2	1.82		
(Fry/m^3 water)	Semi-intensive (4-5 fries)	104	94.54	5.46	***
	Intensive (25 fries)	4	3.64		

***P-[2] between item in column (** = P < 0.01 and *** = P < 0.001); Feddan= 4200 m^2.**

More than 46% of them were intermediate schooling (spend from 9 to 11 years in school for education), and 26% of them were high education. This result was different from **(Njagi *et al.*, 2013)** result, who found that 56.1% of the respondents were studied up to primary school level; and only 1.5% had gone to the university. This can be an indicator that fish breeding is a source of income to the intermediate schooling in Egypt. Eighty-four percent of the respondents were farm owners. About 91% of them were assisted by 10-15 fishing labor in farm work. While 82% and 80% of the respondents had no access to training and credit, respectively, only 69% of them had no access to market information. About 84% of fish farmers were members in a co-operative group. Seventy-four percent of the respondents sold their fish production on the farm gate. More than 55% of fish farmers had a medium farm size (from 10 to 20 feddan). The culture type was polyculture for 76% of the respondents, and the activity type was culture only for 89% of them. The semi-intensive system was the prevailing production system for more than 94% of the respondents.

2. Fish culture farm's performance as measured by a benefit-cost ratio (BCR)

The benefit-cost ratio (BCR) was used to determine the economic performance of fish culture farms. Whereas, it is used as a criterion for evaluating projects **(Gittinger, 1982)**. In this study, BCR was classified as low (≤ 1.45), medium (1.46-2.50), and high (≥ 2.51) with an overall mean of 1.82 as presented in **Table (2)**. Eighty-five percent of the selected fish farms had medium profitability. This was satisfying revenue for the respondents.

Table (2). Numbers, percentages, least-squares means, and standard errors (LSM±SE) of the fish culture farms' production performance as measured by the benefit-cost ratio

Production performance	Farm		LSM±SE
	N	(%)	
Low (≤ 1.45)	10	9.10	1.82±0.02
Medium (1.46-2.50)	94	85.45	
High (≥ 2.51)	6	5.45	

1. Factors affecting the profitability of fish culture farms

Table (3) illustrates the factors which affect the profitability of fish culture farms. Data revealed that there was a negative correlation between the profitability and farmer's age, labor cost, fry price, feed cost, transportation cost, total cost, and mortality rate. In contrast, there was a positive correlation between the profitability and years of experience, the marketing channels, market information, membership in a co-operative group, access to training, access to credit, farm size, culture type, activity type, culture system, fish selling price, and total income. The relation between the profitability and farmers' education years was not significant.

3. Problems facing the fish culture farmers

According to the data in **Table (4)**, there were 20 problems facing the fish culture farmers. One hundred and five out of one hundred and ten of the fish farmers considered high feed prices as a severe problem. This increase in feed price has been attributed to the ingredients importation and the increase of foreign currency exchange rates. Also, about 90% of the feed production comes from the private sector **(El-Sayed *et al.*, 2015** and **USDA,**

2016). Ninety-eight of the fish farmers found a lack of operating capital severe problem, while 99 of them noted severe problem for both energy and fry prices. This result was matched with **(Shaalan *et al*., 2017)** who noted that fry price and accessibility obstacle in the aquaculture industry in Egypt. Also, the majority of the respondents (92, 90, 89, 89, and 85) found lack of credit support, management problems, selling price instability, labor Irregularity, and vaccine unavailability of a severe problem, respectively.

Table (3). Estimates coefficients of factors affecting the profitability of fish culture farms in the studied areas of Egypt.

Variable	Estimate coefficients	SE	t value	P > |t|
Intercept	-0.05073	0.14485	-0.35	0.7270 ^{NS}
Farmer's age (years)	-0.01861	0.04716	-0.39	0.0594*
Experience (years)	0.00198	0.01517	0.13	0.0562*
Education (years)	0.00582	0.00379	0.02	0.9878 ^{NS}
Marketing channels (1 farm gate, 2 middlemen or agents)	0.16646	0.02961	5.62	<.0001***
Market information (1 yes, 2 no)	0.07528	0.02253	3.34	0.0012***
Membership in a co-operative group (1 yes, 2 no)	0.09084	0.04684	1.94	0.0556*
Access to Training (1 access, 2 no access)	0.7972	0.13533	4.50	<.0001***
Access to Credit (1 access, 2 no access)	0.11715	0.03551	3.30	0.0014***
Farm size (feddan)	0.09222	0.02402	3.84	0.0002***
Culture type (1 mono, 2 poly)	0.06501	0.05557	1.17	0.0241*
Activity type (1 culture only, 2 mixed)	0.22111	0.05422	4.08	<.0001***
Culture system (1 extensive, 2 semi-intensive, 3 intensive)	0.08061	0.04493	1.79	0.0561*
Labor cost (L.E)	-0.01882	0.02029	-1.93	0.0361*
Fry price (L.E)	-0.06149	0.04467	-2.38	0.0172**
Feed cost (L.E)	-0.59784	0.19444	-3.07	0.0028**
Transportation cost (L.E)	-0.00925	0.00168	-3.55	0.0582*
Total cost (L.E)	-1.81527	0.24542	-7.4	<.0001***
Fish selling price (L.E)	0.02394	0.01733	4.38	0.0170**
Total income (L.E)	1.20686	0.04271	28.26	<.0001***
Mortality rate (%)	-0.39145	0.22341	-6.30	<.0001***

NS = non-significant, *= P < 0.05, ** = P < 0.01, and ***= P < .0.001.
R^2 = 0.97, Adj. R^2 = 0.96, and Model Sig.= P < .0001***
Extensive system (2 fries/m^3 water), semi-intensive system (4-5 fries/m^3 water), and intensive system (25 fries/m^3 water).

Only three of the respondents found there is no problem for both the high price of vaccination and medication and water low-quality problems. Half of the respondents rated the high mortality rate as severe problem. Fifty-one out of one hundred and ten of the respondents considered lack of bio-security problem as a moderate problem, while the same number of the respondents rated lack of training and technical knowledge severe problem. This result was agreed with what was found by **Shaalan *et al*. (2017)** who cited lack of

technical training as one of the constraints faced by aquaculture in Egypt. Forty of the fish farmers considered brokers and middlemen as a little problem. Almost one-quarter of the respondents noted no problem with poor annual family income. These results are agreed with **El-Sayed (2014)** who found that the main constraints faced by fish farmers in Egypt were: lack the accessibility to credit and financial support, the high prices of feeds, and the feed's poor quality. The same number of the respondents (33) showed the high transportation cost severe problem or no problem. About one-third of the fish farmers confirmed no problem with the lack of feed storage knowledge. Although 79 and 70 of the respondents considered lack of marketing information and lack of fry quality as no problem, only 15 and 26 of them noted it severe problem, respectively.

Table 4. Problems facing the fish culture farmers in the studied areas of Egypt ranked using the problem faced index

Problem	Problem Severity*				PFI**	Score
	FS	FM	FL	FN		
High feed price	105	5	0	0	325	1
Lack of operating capital	98	11	1	0	317	2
High energy price	99	7	4	0	315	3
High fry price	99	5	6	0	313	4
Lack of credit support	92	6	12	0	300	5
Management problems	90	7	13	0	297	6
Selling price instability	89	8	13	0	296	7
Labor irregularity	89	4	17	0	292	8
Vaccine unavailability	85	11	14	0	291	9
High price of vaccination and medication	78	13	16	3	276	10
Water low quality	60	27	20	3	254	11
High mortality rate	55	26	22	7	239	12
Lack of bio-security	43	51	5	11	236	13
Lack of training and technical knowledge	51	20	18	21	211	14
Brokers and middlemen	50	8	40	12	206	15
Poor annual family income	45	15	21	29	186	16
High transportation cost	33	27	17	33	170	17
Lack of feed storage knowledge	25	20	28	37	143	18
Lack of fry quality	26	7	7	70	99	19
Lack of marketing information	15	6	10	79	67	20

*** FS: number of farmers faced a severe problem, FM: number of farmers faced a moderate problem, FL: number of farmers faced a little problem, and FN: number of farmers faced no problem.**
**** PFI (Problem Faced Index) = 3 × FS + 2 × FM + 1 × FL + 0 × FN.**

CONCLUSION

Aquaculture is a source of fish as an alternative for the declining natural ecosystem. Also, it can play a crucial role in raising the level of the social and economic status of fish farmers alleviating poverty, and helping farmers improve their living conditions. In Egypt, although many constraints are facing fish farmers, there is a rapid expansion in aquaculture. The possible approach to increase profitability and build in sustainability measures is not only through promoting new products but also through the existing activities. According to the severity of the problems in the studied areas, the authority should take steps to reduce the price of feed by using alternative feedstuff. Access to operating capital governmental should support small investors in the aquaculture sector. Providing the vaccination and medication at an appropriate price. Also, developing the existing fish hatcheries, and increasing the number of hatcheries to avoid the loss in fertilized eggs or fry will lead to reducing fry price. Implementation of bio-security measures and improving farming practices will help in reducing mortality rates. Efficient veterinary, extension, and training services should be put in place to provide timely delivery of aquaculture information to the fish farmers and increased their building capacity. These suggested solutions are the key to sustainable aquaculture development and will have a direct effect on farmers' profitability.

REFERENCES

Ali, M.S. and **Hossain, M.M. (2010).** Factors influencing the performance of farmers in broiler production of Faridpur District in Bangladesh. World's Poultry Sci. J., **66**: 123-131. Doi:10.1017/s0043933910000127.

Dighiesh, H.S. (2014). Brief summary about aquaculture in Egypt. J. Aquac, Mar. Biol., **1**(1): 3. https://doi.org/10.15406/jamb.2014.01.00003.

El-Sayed, A.F.M. **(2014).** Value chain analysis of the Egyptian aquaculture feed industry. World Fish, Penang, Malaysia Project Report: 2014- 22. https://cgspace.cgiar.org/bitstream/handle/10568/35498/egypt_feeds_2014.pdf;sequence=1.

El-Sayed, A.F.M.; Dickson, M.W. and **El-Naggar, G.O. (2015).** Value chain analysis of the aquaculture feed sector in Egypt. Aquaculture, **437**: 92–101. http://dx.doi.org/10.1016/j.aquaculture.2014.11.033.

FAO (2008). Food and Agriculture Organization. The State of World Fisheries and Aquaculture. Rome, Italy. http://www.fao.org/faostat/en/#data.

FAO (2020). The state of world fisheries and aquaculture. Rome: FAO. http://www.fao.org/documents/card/en/c/ca922 9en.

Feidi, I. (2018). Will the new large-scale Aquaculture projects make Egypt self sufficient in fish supplies? Mediterranean Fisheries and Aquaculture Research, **1**(1): 31–41. https://dergipark.org.tr/en/download/article-file/410652.

Gittinger, J.P. (1982). Economics analysis of agricultural projects. Baltimore and London: Johns Hopkins University. Second ed. 505pp. ISBN 0-8018-2912-7. https://documents1.worldbank.org/curated/en/584961468765021837/pdf/multi0page.pdf.

Greene, W.H. (2008). Econometric analysis. Sixth ed. Pearson Edition, New Jersey 1178pp. https://spu.fem.uniag.sk/cvicenia/ksov/obtulovic/Mana%C5%BE.%20%C5%A1tatistika%20a%20ekonometria/EconometricsGREENE.pdf.

Gujarati, D.N. (2003). Basic Econometrics. Fourth Edition. McGraw-Hill Publishers, New York, USA.

https://www.academia.edu/40263427/BASIC_ECONOMETRICS_FOURTH_EDITION**.**

MALR (2018). Ministry of Agriculture and Land Reclamation Economic Affairs Sector (E.A.S.), Statistics of Agricultural Income Bulletin.

Njagi, K.A.; Njati, I.C. and **Guyo H.S. (2013).** Factors Affecting Profitability of Fish Farming Under Economic Stimulus Programme in Tigania East District, Meru County, Kenya. J. Business and Management, **15**(3): 25-36. Doi.org/10.9790/487x-1532536.

SAS (2012). SAS User's Guide: Statistics. Version 9.4, SAS Inst. Inc., Cary, NC., USA.

Shaalan, M.; El-Mahdy, M.; Saleh, M. and **El-Matbouli, M. (2017).** Aquaculture in Egypt: Insights on the Current Trends and Future Perspectives for Sustainable Development, Reviews in Fisheries Science and Aquaculture. DOI: 10.1080/23308249.2017.1358696.

Snedecor, G.W. and **Cochran, W.G. (1993).** Statistical methods. ISBN: 0-8138-1561-4.

Subasinghe, R.; Soto, D. and **Jia, J. (2009).** Global aquaculture and its role in sustainable development. Rev. Aquacult., **1**: 2–9. Doi.org/10.1111/j.1753-5131.2008.01002.x.

USDA (2016). Egypt: The state and development of aquaculture in Egypt. Available online at http://www.fas.usda.gov/data/egypt-state-and devel opment-aquaculture-egypt.

Wally, A. (2016). The State and Development of Aquaculture in Egypt. Global Agricultural Information Network. USDA Foreign Agriculture Service. 1-4. https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=The%20State%20and%20Development%20of%20Aquaculture%20in%20Egypt%20_Cairo_Egypt_11-6-2016.pdf.