Assessing the Performance of Aquaculture Farms in Egypt

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1. Introduction

- Aquaculture production in Egypt has experienced a substantial growth, establishing the country as the leading producer in Africa and the sixth-largest globally with projected increase in production by 20% through the year 2030 compared to 2020. The fish sector contributed to Egypt's national agriculture income by 11.43% where 80% of production is derived from aquaculture.
- Despite these figures, the aquaculture industry has been facing several challenges that render its growth. Some of these challenges are the inability to use irrigation water, lack of training for aquaculture personnel, the poor control of aquaculture diseases, poor quality of feed and the continuous increase in feed prices.
- With this complex and uncertain situation surrounding the industry, evaluating the performance of aquaculture farms and their ability to overcome the challenges is imperative. However, to the best of my knowledge, technical efficiency of aquaculture farms in Egypt has not been evaluated.

2. Objective

- Assess the performance of the Egyptian aquaculture sector. This will be accomplished by analyzing the efficiency of tilapia farms and investigating the influence of various factors on efficiency.

3. Methods

3.1. Model

- To evaluate the efficiency of the aquaculture farms, stochastic production frontier methodology was adopted. Following the framework outlined by (Aigner et al., 1977) and using trans-log specification, the stochastic production frontier model can be expressed as follows:

$$ln\, Y_i = \beta_0 + \sum_{k=1}^{4} \beta_k\, ln\, x_{ki} + \frac{1}{2}\sum_{k=1}^{4}\sum_{j=1}^{4} \beta_{kj}\, lnx_{ki} lnx_{ji} + v_i - u_i \quad (1)$$

- Following (Battese & Coelli, 1995), the following model will be utilized:

$$u_i = \gamma_0 + \sum_{m=1}^{4} \gamma_m z_{mi} + \epsilon_i \quad (2)$$

where z_{mi} are farm-specific variables associated with technical inefficiencies (the education level and age of the farm owner, the age of the farm facilities, and the number of fish species cultured); γ_0 and γ_m are parameters to be estimated; and ϵ_i is the random error term.

- Additionally, conventional and bootstrap Data Envelopment Analysis (DEA) were used to compare the results from both methods.

3.2. Data

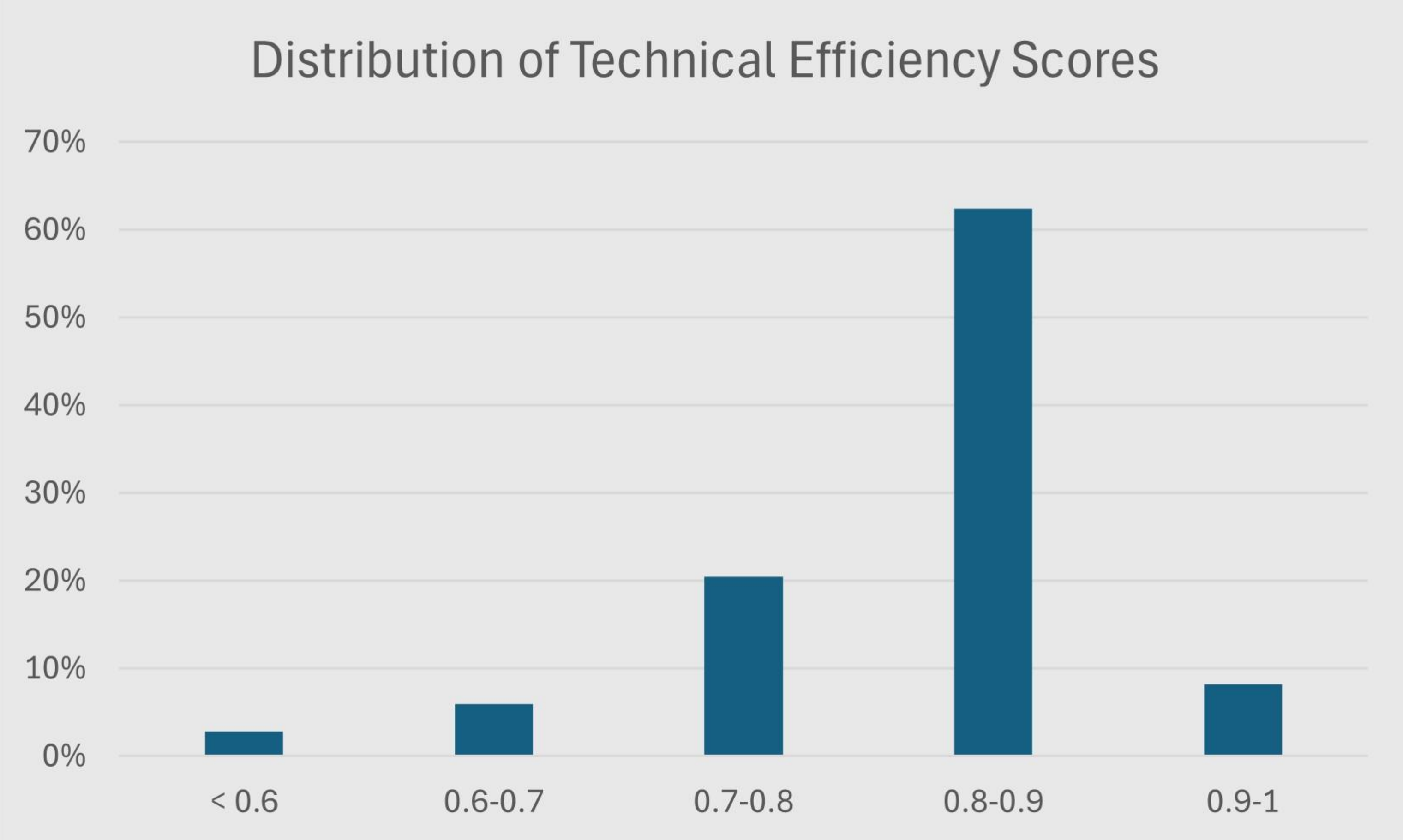
- Data obtained from a cross-sectional survey conducted on aquaculture farms in 2017 in Kafr Elsheikh governorate, Egypt.

Variables	Unit	Mean	SD	Min	Max
Output value (y)	EGP	1,041,000	1,057,000	64,500	8,720,000
Inputs (x)					
Seeds (x_1)	EGP	49,678	51,820	740	400,000
Labor (x_2)	EGP	28,119	26,580	1,800	180,000
Feed (x_4)	Kg	45,788	38,549	4,000	350,000
Land (x_5)	Hectare	5.38	5.05	0.42	50.4
Efficiency drivers (z)					
Farmer's age	Years	43.33	10.90	18	75
Number of species	Levels	2.18	0.75	1	4
Education level	Levels	2.31	1.28	0	6
Farm age	Years	11.88	8.07	1	50

4. Results

4.1. Technical Efficiency

- Average technical efficiency obtained from SFA and DEA were 0.84 and 0.40 respectively. Four outliers were identified by Jackstrap method. After the removal of the outliers, the average technical efficiency using DEA converged to SFA average score. Hence, SFA results are represented.



- Average TE score:0.80.
- Most farms lied in the range of 0.80-0.90 efficiency scores.
- Trans log specification is better fit to the data than Cobb Douglas's.
- Gamma value (γ): 0.63

4.2. Efficiency drivers

Efficiency drivers	Coefficient	SE
Species cultured	0.55**	0.26
Education	0.17	0.13
Farmer age	-0.02	0.02
Farm age	0.04*	0.02

***, * Significant at 5% and 10% levels, respectively*
SE: Standard error

- Efficiency effects model's results indicated that farm age and number of cultured species have negative effect on efficiency at levels of significance of 10% and 5% respectively.
- On the other hand, although not statistically significant, farmers' age might have a positive effect on efficiency while the effect of farmers' level of education might be negative.

5. Discussion

- Average technical efficiency score is in accordance with the findings obtained from other tilapia farms globally.
- The negative effect of farm age on efficiency suggests that older farms tend to be less efficient which might be attributed leapfrogging effect aligning with Nilsen (2010).
- The positive relationship between farmer's age and efficiency can be explained by considering the age a proxy to experience.
- The negative impact of education might be due to having alternative sources of income by highly educated farmers leading them to dedicate less time to their farms.
- The identified negative effect of number of species cultured might be attributed to the varying requirements of fish, the lack of specialization or even improper stocking densities for each species.

6. Conclusion

- Egyptian tilapia production in the sample farms can be increased by 20% using the same levels of inputs.
- Policymakers should invest in human capital within the aquaculture sector through implementing intensive training and extension programs
- Facilitating access to new technology to counteract the aging of older farms may increase the efficiency of tilapia farms. This might involve easing access to credit or providing support for transitioning to farms with more modern technology.

7. References

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