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Study on the Growth Performance of the European Sea Bass (*Dicentrarchus labrax*) in Suez Canal Zone, Egypt

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ABSTRACT

The study involved cultivating 20,000 European seabass (*Dicentrarchus labrax*) in earthen ponds in the Suez Canal region for 540 days, with an average initial wet weight of 30g. During the study, the salinity of the water was 25.75ppt under commercial production conditions, and the water depth in the one-feddan pond at the Suez Canal Fish Farm was approximately 1.25 meters, from June 2020 to December 2021. The fish were fed an artificial diet containing 38% protein from the start of the experiment until its conclusion. At the end of the trial, the European seabass had an average weight of 225.0 ± 22.98g, with a feed conversion ratio (FCR) of 2.00 ± 0.001, and a feed intake (FI) of 4.134 tons per feddan. The specific growth rate (SGR) in weight was 0.37g/ day, and the feed efficiency (FE) was 0.5. The initial body length was 13.6cm, and the final length was 35.2cm, with an SGR in length of 0.18cm/ day. The overall production cost was 151,000 LE per feddan, and 2,067 tons of fish were produced per feddan. The findings indicated that under these experimental conditions, *Dicentrarchus labrax* (European seabass) can be successfully raised in earthen ponds with good growth performance, feed consumption, and net profit.

INTRODUCTION

One billion people globally consume fish, which is a primary source of high-quality protein **(Ahmad *et al.*, 2020; Khalid *et al.*, 2021)**. In 2021, global fish production reached about 33,000 tons, accounting for 11% of total production **(FAO, 2023)**.

Fingerlings produced in hatcheries are the primary source of seabream and seabass in the Mediterranean. However, only a few locations such as Egypt use wild-caught fingerlings **(Muniesa *et al.*, 2020)**.

Seabass and seabream can be cultivated in brackish water and can tolerate a range of salinity levels **(Sadek, 2000)**. In farms that use leftover fish as feed, the feed conversion ratio (FCR) typically ranges between 10 and 12kg of feed per kilogram of fish. However, farms using artificial feed generally have a significantly higher FCR of 2.5–3kg of feed per kilogram of fish **(Haggag, 2017)**.

The most cost-effective strategy among these is raising seabream and seabass in ponds fed with waste fish **(Haggag, 2017)**.

Salinity is a key abiotic factor that significantly impacts the development, body composition, and energy budget of aquatic species. Its complex and widespread biological effects influence numerous physiological and metabolic processes **(Boeuf & Payan, 2001)**.

The objective of the current study was to evaluate the growth performance, feed utilization, and economic viability of seabass raised in ponds with marine water.

MATERIALS AND METHODS

Fish farm and environmental conditions

This study was conducted over 540 days, from June 2020 to December 2021, on a private earthen pond farm in the Ismailia Governorate, covering one feddan. Three earthen ponds, each measuring one feddan in area with a water depth of approximately 1.25 meters, were used. Every three days, one-third of the water was replaced. Physico-chemical parameter sampling was conducted once a week from 9:00 to 12:00.

Water quality parameters, including temperature, dissolved oxygen, pH, and salinity, were monitored every seven days. Water temperature (°C) was measured using a thermometer, salinity was evaluated with a salinity meter, and the values of oxygen and pH levels were measured with an oxygen and pH meter, respectively, following the procedures and techniques outlined in **APHA (1992)**.

Fish stocking and sampling

Twenty thousand fish were stocked per feddan in the pond. After the experiment was completed and the pond was emptied, a thorough census of all the seabass was conducted, including numbering, weighing, and measuring their length.

In June 2020, the seabass (*Dicentrarchus labrax*) fingerlings were collected from the Mediterranean Sea's coastline and the northern shores of Lake Manzala. Every 30 days, a sample of the fish was taken to measure their weight and length. Costs were also recorded to estimate economic efficiency.

The fish, weighing 30.0 ± 0.24g and measuring 13.6 ± 0.5cm at the start, were placed in clay ponds measuring 4,200m² with a water depth of 1.25 meters.

Fish feeding and sampling

Over the course of the 540-day study, the fish were fed a commercial pelleted feed diet (Alar Aqua Company) that had 38% protein and 12% lipid. The fish were fed three times a day at 8:30, 12:00, and 16:30 until they reached an average weight of 100g. The quantity of feed fed to the fish was noted at the conclusion of each day. Fish were randomly selected from the ponds once a month, sedated with 2-phenoxyethanol (1ml L^{-1} water), and their average wet weight was recorded using a 0.01g sensitive scale in order to track their growth and get information on feed evaluation.

It was acknowledged that the fish's adaption to the experimental conditions was the reason it wasn't fed for the first three days of the trial.

Growth performance and feed utilization parameters

After the experimental trial, all the fish were fasted for 24 hours. They were then carefully removed from the ponds, and their weight was recorded. Growth indicators, including the terminal average weight (TAW), survival rate (SR), specific growth rate (SGR), and feed conversion ratio (FCR), were calculated using the following equations according to **Carlos (1988)**:

$$WG = (W_f - W_i)$$

Where, W_f (final weight, W_i (initial weight)

$$DGR = (W_f - W_i) / t,$$

Where, t (period of trial)

$$WG\ \% = (W_f - W_i)/W_i x100,$$

$$SGR\ (\%/d) = 100 \times (LnW_f - LnW_i) / T,$$

Where, Ln, natural Log

$$FCR = F\ I / (W_f - W_i) \text{ where FI (Feed intake)}$$

$$FE = (W_f - W_i) / FI$$

$$\text{Condition factor (K) } K = ([Wt\ (gm)] / [L\ (cm)]^3 \text{ x } 100)$$

Where, Wt: the total body weight; L: the total body length.

Survival rates (%)

Survival rates (%) were estimated as: N_o. of fish harvested/N_o. of fish stocked x100.

$$SR\ (\%) = 100 \times N_f/N_i$$

Economical evaluation

The experiment's profitability was estimated using a basic economic evaluation according to the following equations:

a. Fingerlings source, costs and quantities.
b. Feeding source, costs and quantities.
c. Pond aeration.
d. Labor
e. Fish production
f. Fingerlings cost= No. fish X price of each
g. Feed cost= amount of feed X price per /kg

Total production (kg /feddan) = No. of fish at Harvest X average body weight

Total income L.E/ feddan = Total production (kg /feddan X price of Kg)

Net return L.E/ feddan = Total income L.E /feddan - Total cost.

RESULTS

Physico-chemical parameters

An overview of the seabass raised in an earthen pond throughout the trial period at the Suez Canal Fish Farm in the Ismailia Governorate is provided by the mean values of several water quality indicators, including salinity, pH, temperature, and dissolved oxygen. During the study, the water temperature ranged from 18.0 to 36°C, with an average of 27°C. The lowest recorded temperature was 18°C in December and January, while the highest temperature reached 36°C in July. Temperature variations were observed throughout the study period.

The average water salinity during the study was 25.75ppt, with a range of 24 to 27.5ppt. The average dissolved oxygen level in the seabass ponds was found to be 4.5 ± 0.93mg/ L.

Table 1. Water quality parameters for the Suez Canal fish farm throughout the experimental period (540 days)

Month	DO mg/L	Salinity (ppt)	Temperature° C	pH
June 2020	5.00	25.00	33.20	8.00
July	4.90	25.00	35.70	7.90
August	4.50	25.00	33.80	7.40
September	4.00	24.00	30.10	7.50
October	4.00	24.20	25.20	8.00
November	4.20	24.50	22.20	8.10
December	4.90	25.20	18.00	8.20
January 2021	4.90	25.20	16.50	8.90
February	4.20	25.50	20.00	8.00
March	4.10	25.00	21.80	8.20
April	4.20	26.50	21.70	8.10
May	4.10	26.00	22.00	8.10
June	4.20	27.50	33.20	8.10
July	4.20	27.00	35.50	8.30
August	4.20	27.00	36.00	8.10
September	4.10	27.00	30.10	8.10
October	4.20	24.00	24.20	8.10
November	4.10	24.00	20.20	8.30
December 2021	4.20	24.20	19.50.00	8.00

Table (2) offers a monthly log of a fish's development following a stocking. The information includes mean total weight, mean total length, weight increment, and weight gain per day. The initial measurements were 13.6cm in length and 30 in weight when the item was first stocked in June 2020. According to the statistics, weight increments peaked in the first few months, and growth was steady over that time.

Weight growth by daily weight gain (0.40g) in July was 12.12, however the daily weight gain decreased to 0.45g by December (180 days later), bringing the total weight to 110.12g. After 360 days, the weight was reported in June at 178.61g, with a 0.41g daily weight growth. The growth rate dropped in the following months starting in August (420 days), with weight increments falling with time to just 2.93g in November and December, with a daily gain of 0.10g.

Table 2. Monthly variations in growth of sea bass (*Dicentrarchus labrax)* reared in brackish water fish farms

Month	Days after stocking	Mean total length	Mean total weight	Increment in weight (g)	Daily gain in weight (g)
June 2020	0	13.6	30	0.0	0.0
July	30	14.95	42.12	12.12	0.40
Aug.	60	17.06	58.45	16.33	0.54
Sept.	90	18.10	73.57	15.12	0.50
October	120	19.0	87.24	13.67	0.46
November	150	19.50	100.12	12.88	0.43
December	180	20.00	110.12	10.00	0.33
Jan.	210	20.60	119.35	9.23	0.31
Feb.	240	21.00	128.36	9.01	0.30
March	270	23.70	138.92	10.56	0.35
April	300	25.89	151.37	12.45	0.42
May	330	27.73	165.49	13.12	0.44
June	360	29.05	178.61	14.47	0.48
July	390	31.40	193.08	15.13	0.50
Aug.	420	33.02	206.21	7.54	0.25
Sept.	450	34.10	213.75	5.32	0.18
Oct.	480	34.50	219.07	3.00	0.10
Nov.	510	34.98	222.07	2.93	0.1
Dec. 2021	540	35.2	225	2.93	0.1

Table 3. Growth performance of the seabass reared on fish farms belonging to Suez Canal Company throughout the experimental period (540 days) from June 2020 to December 2021

Parameter	**Values**
Average Initial body weight (g)	30.00 ±0.24
Average Final body weight (g)	225 ±6.03
Weight gain (g)	195 ±4.22
Weight gain/day	0.36± 0.002
Weight gain (%)	650±10.20
SGR in weight	0.37±0.003
Average initial body length (cm)	13.6±0.300
Average final body length (cm)	35.2±0.50
Gain in length (cm)	21.6±1.04
SCR in length % /day	0.18±0.00
Survival rate (%)	53±2.01
Food intake (kg/ feddan) 390	4.134
Food Conversion ratio	2.0 ± 0.001
Feed Efficiency	0.5 ± 0.005
Condition factor	0.51±0.02
Total weight at stocking kg/feddan	600
Total weight at Harvest kg/feddan [1]	2.385
Net production ton /feddan	1,785

The growth performance of seabass (*Dicentrarchus labrax*) on the Suez Canal Fish Farm in the Ismailia Governorate is summarized in terms of initial weight, final weight, specific growth rate (SGR) in weight, survival rate, and daily weight gain (Table 3).

At the end of the 540-day rearing period, each fish had an average weight of 225g. The weight of each fish increased by 195g, or 0.36g per day, with a weight gain percentage of 750%. The condition factor (CF), SGR, and final body length were 35.2, 0.18, and 0.51, respectively.

Economical evaluations

The goal of this research was to determine the profitability of seabass production in the study area. This includes estimating the expenses and profits associated with fish farming. A comprehensive cost and return analysis were conducted by examining the yield, output data, and input costs to assess profitability.

The economic viability and profitability of seabass farming in the research area were evaluated. The results indicated that the largest portion (37%) of the total production cost was attributed to feed expenses, followed by the cost of fingerlings (26%), labor, and other variable costs (20%).

The total costs per feddan (including fingerlings, feed, labor, oil, rent, and other expenses) amounted to 151,000 LE. The total production was 2,067 tons, with a total income per feddan of 186,030 LE, and a net return of 35,000 LE.

These findings clearly show that large fish farmers in the study area spend a significant amount of money on purchasing feed.

Table 4. Average cost and return of seabass in Suez Canal region

Item	Rate	%
Costs/ feddan		
Fingerlings costs LE	40,000	26
Feed cost LE	56,000	37
Labor and other costs LE	30,000	20
Oil+ rent + other	25,000	17
Total costs LE feddan	151,000	100
Income feddan (LE)		
Total production (ton /feddan)	2,067	
Price (LE) of one kg fish	90	
Total income LE/ feddan	186,030	
Net return LE/ feddan	35,000	

DISCUSSION

Fish growth is influenced by several basic elements, including salinity, age, gender, dissolved oxygen levels, water temperature, and other water quality indicators that fall under the category of external influences **(Laiz-Carrion *et al.*, 2005)**.

The Suez Canal fish farm's reported average temperatures fell between 14.3 to 32.4°C, which is within the wider optimal range for tropical pond fish breeding according to **Hossain *et al.* (2006)**. The ideal temperature range for seabass (*Dicentrarchus labrax*) growth is normally between 17 and 21°C, while temperatures below 13°C drastically decrease feeding activity according to **FAO (2002)**.

Seabass can withstand a pH range of 7.4 to 8.9, while the average pH on the farm was 8.15. Seabass should have a dissolved oxygen (DO) content of 4.5mg/L, with a range of 4.0 to 5.0mg/L. Variations in dissolved oxygen and pH were comparatively constant over the productive range. These results are consistent with **El-Shebly (2009)**, who stated that their average pH was 8.1, which is within the range that is advised for fish production.

After adjusting for environmental and seasonal variables, the outcomes were comparable to **Ercan *et al.* (2015)**.

Quemener (2002) showed similar outcomes, determining that the optimal temperature range for seabass growth was 16 to 20°C. On the other hand, **Boyd (1992)** demonstrated that the optimal temperature range for fish growth and productivity is 26 to 31°C. Notably, temperature may not be the only factor that fully explains differences in plankton and fish production; pH, alkalinity, carbon dioxide, and nutrient levels are all significant factors that affect overall productivity **(Begum *et al*., 2007; Hossain *et al*., 2007)**.

In intensive marine fish farming, salinity plays a significant role according to **Cataudella *et al.* (1995a, b)**. Seabass are euryhaline fish that may live in brackish areas, lagoons, and river mouths that are open to the sea. It is also anticipated that the European seabass will be able to continue flourishing in low salinities. The European seabass and gilthead seabream, grown at a salinity of 7‰, weighed more than 300g on average at the end of a 20-month study. The study's FCR values were found to be lower than those of the European seabass and the gilthead seabream raised in net cages and tanks in the ocean **(Campos *et al*., 2017)**.

According to **El-Shebly (2005)**, a seabass's daily weight might increase to 164g. Nevertheless, these numbers are more than those found in previous research, including those of **Risk and Hashem (1981)** and **Osman and Sadek (2002)**. The new study's findings are consistent with past research. With a specific growth rate of 0.7g, the average weight gain per fish in this study was 0.40g per day. **El-Shebly (2005)** discovered that the seabass might gain up to 1.13g per fish each day, albeit this amount might change depending on the species or habitat. In this investigation, the fish were given a synthetic diet from Alar Aqua Company. This promoted healthy growth and feed efficiency and had 38% of crude protein. Marine fish require a diet high in protein (40–60%) in order to grow according to **Tibaldi *et al.* (2006)** and **El-Shebly *et al*. (2007)**.

The study's fish reached an average final length of 35.2cm and weight of 225 grams per piece in their second year of growth, with an average condition factor of 0.51. These outcomes are comparable to **El-Shebly *et al.* (2009)**. They found that seabass raised in culture had a condition factor of 1.05, with a range of 0.88 to 1.27. As stated by **Sharaf (1987)**, as fish length rises, the condition factor (k) tends to decrease. The average condition factor for seabass in the Suez Canal region was 1.43.

Compared to other fish species, marine fish, such as seabass, usually need more protein in their diet. As mentioned by **Peres and Oliva (2003)**, in marine fish, lowering protein intake has a detrimental effect on growth rates, feed consumption, and feed efficiency. The food conversion ratio (FCR) in this investigation was 2.0, which is greater than the figures recorded in prior investigations. **Campos *et al.* (2017)** recorded an FCR of 1.84 for pompano. **Manomaitis and Cremer (2007)** reported values ranging from 2.51

to 2.59, **Lan *et al*. (2008)** found an FCR of 3.0, and **McMaster *et al*. (2008)** observed FCR values between 2.13 and 2.23. Fish age, species, eating habits, and variations in the experimental design could all be contributing factors to this discrepancy.

This study recorded a survival rate of 53% which is in line with the results of **El-Shebly *et al*. (2007)**, who observed similar results. The profitability of fish farming, as shown in the studies of **Ashaolu *et al.* (2006)**, who backs up the findings of the present study. This implies that a farmer can still turn a sizable profit after paying back a loan they took out to support seabass cultivation. Fish farming, especially seabass farming, provides higher nutritional and economic returns than conventional cattle farming according to **Hickling (1962)**. According to the findings, the production of seabass is a profitable industry with room for growth in aquaculture projects in Egypt and other places.

According to **Laiz *et al*. (2005)**, fish meal, a crucial ingredient in many artificial fish meals, is expensive, which raises the cost of manufacture. For using surplus fish and fish waste, this study addressed this issue by introducing an alternate aquaculture feeding strategy in Egypt that was proven to greatly improve the seabass farming process.

Sea bass may be commercially raised in both low-salinity brackish waters and earthen ponds, and sea bass have substantial economic importance for the Mediterranean nations. These results align with the findings of **Altan (2020)**.

CONCLUSION

Based on this experimental investigation, it can be concluded that seabass specimens were successfully farmed in earthen ponds and generated a healthy profit.

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