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Economic Study of Marine Fish Farming in Alexandria Governorate (Case Study of the Kilo 21 Hatchery)

Dr. Doaa Ibrahim Abdel Hamid Hashem, Dr. Engy Ahmed Teimaa and Dr. Elham Shaaban Abd Elsalam Pargal

Researcher at Agricultural Economic Research Institute, ARC, Egypt
Email: drdoaah82@gmail.com

Abstract: Due to the scarcity of fresh water needed to be used in many fields, including fish farming, the prevailing trend is marine culture to develop fish wealth, as the expansion of marine fish farming contributes to increasing local production of fish and reduces the size of the gap between production and consumption. In light of the small number of hatcheries that produce marine fish larvae; which requires studying the basic requirements and the financial feasibility for establishing such hatcheries. The research aimed to study the current situation of the most important types of fish from marine aquaculture in Alexandria Governorate, to prepare the basic steps necessary to conduct a technical and economic feasibility study for the kilo 21 hatchery to guide investment in this field. **The most important research results were the following:** (1) The main types of fish farms in Alexandria governorate are government farms and private rented farms, while possession private farms and intensive farming do not represent a great importance in fish production from existing farms in the governorate. (2) The variety of fish cultured in Alexandria governorate varies according to the type of water used in culture. It was found that the fish that are farmed in fresh water are represented by tilapia, catfish and carp contribute about 0.32%, while those cultured in mixed water are represented by the mullet family. It contributes about 38.70%. As for the fish that are farmed in sea water (marine fish), represented by bream and seabass, they contribute an estimated 37.81% of the average fish production from fish farming. (3) It was found that the production of larve and fingerlings of bream and seabass for the 21 kilo hatchery was about 4.28 million units during the average period (2015-2020). (4) It was found that the kilo 21 hatchery is characterized by its ability to overcome the problems of climatic changes on the larvae by using the simulation method and controlling the temperatures throughout the year. (5) The tendency of breeders to buy fingerlings for larvae in order to avoid waste and cost. (6) From the financial feasibility study of the project to establish a fish hatchery, it was found that the net present value of the project amounted to about 450.8 million pounds, the internal rate of return was about 54.3%, which is higher than the interest rate on loans and deposits, which is estimated at about 12%. This means that the project is financially and economically viable. (7) The analysis of the sensitivity of the project's internal rate of return to changes in revenues and costs showed that the internal rate of return is more sensitive to a decrease in revenues than an increase in costs in the same proportion, and it was also found that the project remains economically rewarding even in the case of delaying the start of the farm operation for a period of up to 3 years.

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1. Introduction:

Fish production is an important source of animal protein, as its availability is linked to achieving food security and providing nutritional needs as one of the most important objectives of the Egyptian agricultural economic policy. The fisheries sector is one of the main pillars of agricultural income, as the income from this sector amounted to about 61 billion pounds, representing about 11.42% of the total agricultural income of about 534.3 billion pounds, and it achieves a net income of about 56.3 billion pounds, which is estimated at 16 25% of the total net agricultural income, amounting to about EGP 346.4 billion in 2019/2020, in addition to contributing to increasing food security from animal protein due to the many problems that limit the expansion of red and white meat production, where most of the requirements are imported Livestock production from abroad in addition to the increasing demand and high prices.

Fish production from fish farming ranked first, reached about 1.59 million tons, with an estimated rate of 79.18% of the total fish production at the level of the Republic, amounted to about 2.01 million tons,

followed by fish production from natural fisheries, which amounted to about 418.68 thousand. tons with an estimated rate of 20.82% of the total fish production at the level of the Republic, which includes each of the fish production from lakes, which amounted to about 237.76 thousand tons, followed by the production of fish from marine fisheries, which amounted to about 101,39 thousand tons, while the production of fish from marine fisheries amounted to about 101,39 thousand tons. Fresh water fisheries about 79,53 thousand tons in 2020.

Since fish larvae is one of the most important basic elements in fish farming, the available volume is one of the most important determinants of fish farming, especially marine fish farming, where laws and legislation limit the overfishing of marine fish larvae, which requires the establishment of hatcheries for spawning marine fish. Especially bream and sea bass to meet the needs of fish farms and to keep away from the control of environmental and weather conditions in light of climatic changes.

The main objective of the 2030 strategy is to develop the fisheries sector through fish farming to double production to reach about 2 million tons, which leads to an increase in the average per capita consumption to about 18.5 kg through the expansion of the establishment of farms on the one hand and the development in the production of larvae from fish hatcheries, both governmental or private on the other hand.

Research Problem:

Due to the scarcity of fresh water needed to be used in many domains, including fish farming, the prevailing trend is marine culture to develop fish wealth, as the expansion of marine fish farming contributes to increasing local production of fish and reduces the size of the gap between production and consumption, and in light of the small number of hatcheries that produce marine fish larvae; This requires studying the basic requirements and financial feasibility for establishing such hatcheries.

Research objectives:

In the light of the research problem, the research objectives were identified as follows:

1. Studying the development of production, area and productivity of fish farming in Alexandria Governorate
2. Studying of the varietal composition of fish farming according to water quality in Alexandria Governorate
3. Studying of the current situation of the most important types of fish from marine aquaculture in Alexandria Governorate
4. Preparation of basic steps required for conducting a technical and economic feasibility study for the kilo 21 hatchery to guide investment in this field.

2. Methodology and data sources:

Both descriptive and quantitative economic analyses were used, where financial analysis criteria were used to evaluate the project of establishing a fish hatchery as criteria: present value of net income, benefit-cost ratio, internal rate of return, capital payback period. In addition to the criteria for sensitivity analysis of the project, whether by changes in income or costs or both, as well as the delay in starting the implementation of the project, and the Cost Ben program was used.

In achieving its objectives, the research relied on published secondary data such as the General Authority for Fisheries Development, in addition to references and research related to the research topic.

In order to prepare the financial feasibility study for the project to establish a fish hatchery, the actual data of each of the items of investment costs and operational costs as well as items of income were relied on. This was collected in 2021 through a personal interview through field visits to the Kilo 21 hatchery in Alexandria Governorate.

3. Results and Discussion:

Firstly: Development of production, area and productivity of fish farming in Alexandria Governorate:

1) Development of fish farming production in Alexandria Governorate:

The main types of fish farms in Alexandria governorate are governmental farms and private rented farms, while private ownership farms and intensive farming do not represent much importance in fish production from existing farms in the governorate. By reviewing the data contained in Table (1), the following becomes clear:

The development of fish production from fish farms in Alexandria Governorate during the study period (2005-2020) ranged between a minimum of about 0.95 thousand tons in 2006, and a maximum of about 12.75 thousand tons in 2019, with an annual average of about 4.99 thousand tons, and an estimate The annual rate of change of fish production from fish farms in Alexandria governorate showed that it tended to increase at an annual rate of about 12% at a significant level of 1% during the study period. It was found that fish farming contributed about 21.05% of the total fish production in Alexandria Governorate.

The relative importance of the different types of fish farms according to the average period of the study showed that: The private rented farms ranked

first in terms of production quantity, as the average production during the study period was about 4.18 thousand tons, this quantity represented about 94.19% of the total Fish production from fish farming in the governorate, followed by government farms, with an average production of about 0.24 thousand tons. This amount represents about 4.81% of the total fish production from fish farming in the governorate. The private farms, the private, come in third place. The average amount of fish production amounted to about 0.09 thousand tons, representing about 1.8 percent of the total fish production from aquaculture in the governorate.

The development of fish production from governmental fish farms in Alexandria governorate during the study period showed that it ranged between a minimum of about 0.04 thousand tons in 2020, and a maximum of about 0.73 thousand tons in 2018, with an annual average of about 0.24 thousand tons by estimating the annual rate of change of fish production from governmental fish farms, it was found that it tended to decrease at an annual rate of about 12% at a significant level of 1% during the study period.

The development of fish production from private fish farms (private) in Alexandria Governorate during the study period, it was found that it ranged between a minimum of about 0.01 thousand tons in 2009, and a maximum of about 0.26 thousand tons in 2019, with an annual average of about 0, 09 thousand tons, and by estimating the annual rate of change of fish production from private fish farms, it was found that it tended to increase at an annual rate of about 17% at a significant level of 1% during the study period.

The development of fish production from private fish farms (rent) in Alexandria governorate during the study period, it was found that it ranged between a minimum of about 0.38 thousand tons in 2006, and a maximum of about 12.51 thousand tons in 2020, with an annual average of about 4. 70 thousand tons, and by estimating the annual rate of change of fish production from private fish farms (rent), it was found that it tended to increase at an annual rate of about 19% at a significant level of 1% during the study period.

Table (1) Fish farming production in Alexandria Governorate according to its various sources during the period (2005-2020).

Year	Governmental Farms	Private Farms (owned)	Private Rent Farms	Total Farms	Total production (fisheries – farming)
2005	0,46	0,19	3,86	4,51	22,47
2006	0,56	0,01	0,38	0,95	25,15
2007	0,45	0,03	0,97	1,46	22,94
2008	0,34	0,01	0,94	1,29	25,62
2009	0,19	0,01	1,13	1,33	22,22
2010	0,33	0,03	2,42	2,6	25,64
2011	0,14	0,03	2,32	2,49	25,19
2012	0,13	0,03	2,33	2,49	25,01
2013	0,11	0,036	2,34	2,49	22,23
2014	0,09	0,05	4	4	20,16
2015	0,07	0,072	4,71	4,85	21,57
2016	0,075	0,11	7,08	7,26	20,80
2017	0,084	0,187	9,55	9,83	22,11
2018	0,73	0,18	8,804	9,06	20,46
2019	0,12	0,26	12,37	12,75	25,68
2020	0.04	0.26	12.50	12.81	31.05
Average	0.24	0.09	4.70	4.99	23.70
Change Rate %	**(0.12)**	**0.17**	**0.19**	**0.15**	**0.001**

** Significant at 0.01 level. ( ) The values in parentheses are negative.

Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation, General Authority for Fisheries Development, Fisheries Statistics Annual Book, Cairo, separate issues.

2) Development of the area of fish farming in Alexandria Governorate:

It is evident from the study of the development of the area of fish farms in Alexandria Governorate during the period (2005-2020), and by reviewing the data contained in Table (2), the following shows:

Development of the area of governmental fish farms in the Alexandria Governorate during the study period, it was found that it ranged between a minimum of about 1.5 thousand feddans in 2019 and 2020, and a maximum of about 6.7 thousand feddans in 2005 with an average of 4.7 thousand feddans, with an average estimate of The annual change in the area of governmental fish farms shows that it tends to decrease at an annual rate of about 11% at a significant level of 1% during the study period.

The development of the area of private fish farms (owned) in Alexandria Governorate during the study period, it was found that it ranged between a minimum of about 51 acres during the period (2008-2012), and a maximum of about 131 feddans in 2006, and 2007 with an average of about 81 feddans, and it has not been proven Statistical significance of the annual rate of change of fish production from private fish farms (own) due to the relative stability of the area during the study period.

The development of the area of private fish farms (rent) in Alexandria Governorate during the study period, it was found that it ranged between a minimum of about 3.74 thousand acres in 2008, and a maximum of about 4.72 thousand acres in 2016 with an average of about 4.4 thousand feddans, By estimating the annual rate of change of the area of private fish farms (rent), it was found that it tends to increase at an annual rate of about 1% at a significant level of 1% during the study period.

The development of the total area of fish farms in Alexandria Governorate during the study period showed that it ranged between a minimum of about 5.9 thousand feddans in 2018, and a maximum of about 11,49 thousand feddans in 2016 with an average of about 9.2 thousand feddans. By estimating the annual rate of change of the total area of fish farms in the governorate, it was found that it tends to decrease at an annual rate of about 4% at a significant level of 1% during the study period.

Table (2): The development of the area of fish farms in Alexandria Governorate during the period (2005-2020). (Feddan)

Year	Governmental Farms	Private Farms		Total fish farms
		Owned	Rented	
2005	6721	129	3856	10706
2006	6681	131	3786	10598
2007	6688	131	3891	10710
2008	6688	51	3742	10481
2009	6688	51	4498	11237
2010	6688	51	4483	11222
2011	3320	51	4634	8005
2012	4676	51	4659	9386
2013	6488	71	4687	11246
2014	6488	71	4711	11270
2015	1492	71	4711	6274
2016	6701	71	4717	11489
2017	1517	91	4402	6010
2018	1492	91	4402	5985
2019	1492	91	4419	6002
2020	1492	91	4467	6050
Average	**4707**	**81**	**4379**	**9167**
Annual Change Rate %	****(0.11)**	**٤٫٠0.11**	****0.01**	**** (0.04)**

** Significant at 0.01 level. *Significant at the 0.05 level of significance. ( ) The values in parentheses are negative.

Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation, General Authority for Fisheries Development, Fisheries Statistics Annual Book, Cairo, miscellaneous issues.

3) development of fish farming productivity in Alexandria Governorate:

By reviewing the data in Table (3), it becomes clear that:

The development of fish productivity from governmental farms at the level of Alexandria Governorate during the study period, it was found that it ranged between a minimum of about 0.01 tons / feddan in 0162, and a maximum of about 0.49 tons / feddan in 2018 with an average of about 0.07 tons / feddan The statistical significance of the annual productivity change rate of governmental fish farms was not proven due to the relative stability of the data during the study period.

The development of fish productivity from private farms (owned) in Alexandria Governorate during the study period, it was found that it ranged between a minimum of about 0.08 tons / feddan in 2019, and a maximum of about 2.90 tons / feddan in 2020 with an average of about 1.09 tons / feddan, By estimating the annual rate of change in productivity from private fish farms, it was found that it tended to increase at an annual rate of about 17.5% at a significant level of 1% during the study period.

The development of fish productivity from private farms (rent) in Alexandria Governorate during the study period, it was found that it ranged between a minimum of about 0.10 tons / feddan in 2006, and a maximum of about 2.80 tons / feddan in 2019 with an average of about 1.06 tons / feddan By estimating the annual rate of change in productivity of private fish farms rent, it was found that it tended to increase at an annual rate estimated at 17.4% at a significant level of 1% during the study period.

The development of fish productivity from the total fish farms in Alexandria Governorate during the study period, it was found that it ranged between a minimum of about 1.81 tons in 2016 and a maximum of about .738 tons in 2020, with an average of about 2.83 tons, and an estimate of the annual rate of change of productivity from the total Fish farms showed that it tended to increase at an annual rate of about 4.6% at a significant level of 1% during the study period.

Table (3): The productivity of fish farms in Alexandria Governorate during the period (2005-2020). (ton/feddan)

Year	Governmental Farms	Private Farms		Total fish farms
		Owned	Owned	
2005	0,07	1,47	1,00	2,1
2006	0,08	0,08	0,10	2,37
2007	0,07	0,23	0,25	2,14
2008	0,05	0,20	0,25	2,44
2009	0,03	0,20	0,25	1,98
2010	0,05	0,59	0,54	2,28
2011	0,04	0,59	0,50	3,15
2012	0,03	0,59	0,50	2,56
2013	0,02	0,51	0,50	1,98
2014	0,01	0,70	0,85	1,94
2015	0,05	1,01	1,00	3,44
2016	0,01	1,55	1,5	1,81
2017	0,06	2,05	2,17	3,68
2018	0,49	1,98	2,00	3,42
2019	0,08	2,86	2,8	4,28
2020	0.027	2.901	2.800	5.728
Average	**0.03**	**2.90**	**2.80**	**5.73**
Annual Change Rate %	0.01	**17.5	**17.4	4.6**

** Significant at 0.01 level. *Significant at the 0.05 level of significance.

Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation, General Authority for Fisheries Development, Fisheries Statistics Annual Book, Cairo, miscellaneous issues.

Secondly: The varietal composition of fish farming according to water type in Alexandria Governorate:

By reviewing the varietal composition of fish farming production during the average period (2015/2020), Table (4) shows the following:

1- Pure water: The variety of fish cultured in Alexandria governorate varies according to the type of water used in the culture. It was found that the fish that are farmed in fresh water, such as tilapia, catfish and carp, contribute about 0.32% of the average fish production from aquaculture.
2- Mixed waters: As for the fish that are farmed in mixed waters, which are the fish of the mullet family, they contribute about 38.70%.
3- Saline water: while the fish that are farmed in salt water (marine fish), represented by bream and sea bass, contribute an estimated 37.81% of the average fish culture from the culture during the average study period.

Table (4): Production from fish farming in Alexandria governorate and its varietal composition according to the quality of the water used in culture during the average period (2015/2020).

Years	Pure Water			Mixed Water	Saline water		Total of Alexandria Production
	tilapia	catfish	carp	mullet	bream	Sea bass	
2015	31	2	2	**1708**	1904	1200	4847
2016	38	3	6	2546	2859	1797	7249
2017	49	11	20	3969	3590	2186	9825
2018	25	21	5	3697	3460	1851	9059
2019	12	32	10	5007	4745	2916	12722
2020	26	13	0	4945	4812	3016	12812
Average	**30.17**	**13.67**	**7.17**	**3645.33**	**3561.7**	**2161**	**9419**
%	**0.32**	**0.15**	**0.08**	**38.70**	**37.81**	**22.94**	**100**
%	**0.32**			**38.70**	**37.81**		

Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation, General Authority for Fisheries Development, Fish Statistics Annual Book, Cairo, Issues (2015-2020).

Thirdly: The current situation of the most important varieties of marine aquaculture in Alexandria Governorate:

In the following, we review the current situation of the most important types of marine aquaculture in Alexandria, represented by sea bream and sea bass.

Fish farming from bream is classified according to its various sources in Alexandria Governorate during the average period (2015-2020) to private and rented farms, while fish farming is classified from sea bass to governmental and private farms, and by reviewing the data contained in Table (5, 6) it is clear the following:

(1) Fish farming of bream and sea bass according to its sources in Alexandria Governorate:

Fish farming from bream is classified according to its various sources in Alexandria Governorate during the average period (2015-2020) to owned and rented farms, while fish farming is classified from seabass to governmental and private farms, and by reviewing the data contained in Table No. (5), the following is shown:

Fish farming of bream: the average production of private farms of the king is about 60.5 tons, while the average production of private rented farms is about 3501.17 tons.

Seabass farming: the average production of governmental farms is about 0.7 tons, while the average production of private, owned and leased farms is about 28.33 and 2132 tons, respectively.

Table (5): Fish farming of bream and seabass according to its sources in Alexandria Governorate during the average period (2015-2020)/ (ton).

Years	seabream production		seabass production		
	Private Farms		Governmental Farms	Private Farms	
	Owned	Rent		Owned	Rent
2015	26	1878	4	16	1180
2016	38	2821	0	24	1773
2017	69	3521	0	35	2151
2018	59	3401	0	20	1831
2019	84	4661	0	36	2880
2020	87	4725	0	39	2977
Average	**60.5**	**3501.17**	**0.7**	**28.33**	**2132**

Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation, General Authority for Fisheries Development, Fish Production Statistics Book, Cairo, miscellaneous issues.

(2) Production of marine fish larvae and fingerlings at the kilo 21 hatchery in Alexandria:

The Kilo 21 hatchery in Alexandria is the only governmental hatchery at the level of the Republic, which is characterized by the production of larvae and fingerlings from marine fish of the sea bream and bass classes until 2020, Where the Ghalioun marine hatchery of the National Company was established in Damietta for the development of marine fish farming at the level of the Republic, and it is clear from the data in Table No. (6) That the total quantity of larvae and fingerlings production of sea breams and seabass amounted to about 4.28 million units during the average period (2015-2020).), as it turns out that:

Production of larvae and fingerlings of seabream: the average production of larvae of bream is about 0.46 million units, while the average production of fingerlings from bream is about 1.83 million units.

Production of larvae and fingerlings from seabass: the average production of larvae from seabass is about 0.38 million units, while the average amount of fingerling production from seabass is about 1.61 million units.

It was found that the breeders tend to buy fingerlings for fry in order to avoid the percentage of wastage during the incubation of the larvae.

Fourthly: The basic requirements for conducting a technical and economic feasibility study for the Kilo 21 hatchery:

The importance of the project as a hatchery for mariculture is due to the fact that it is considered unrivaled as the first governmental experiment in Egypt in terms of the production of larvae for seabass and bream due to its high nutritional value in international markets. From 15% to 20% of the total needs of fingerling fish farms, as well as its contribution to eliminating the overfishing of larvae.

This hatchery is characterized by optimizing the exploitation of all underutilized assets and making the maximum use of them. It has been developed recently, and its construction has expanded to include modern technological hatcheries and training centers.

Table (6): the production of the larvae of sea bream and fingerlings at kilo 21 in Alexandria, during the average period (2015-2020). /(millions)

Years	Larvae **production**		Fingerlings Production		**Total**
	bream	**bass**	**bream**	**bass**	
2015	0.32	1.28	1.41	3.00	6.00
2016	0.48	1.90	0.24	3.39	6.00
2017	0.34	1.34	0.55	1.28	3.50
2018	0.66	2.65	0.00	0.19	3.50
2019	0.44	1.76	0.00	1.00	3.20
2020	0.50	2.02	0.08	0.80	3.40
Average	**0.46**	**1.83**	**0.38**	**1.61**	**4.28**

Source: Compiled and calculated from:
(1) Ministry of Agriculture and Land Reclamation, General Authority for Fisheries Development, Fish Production Statistics Book, Cairo, miscellaneous issues.
(2) Ministry of Agriculture and Land Reclamation, General Authority for Fisheries Development, hatchery records of Kilo 21, unpublished data, Alexandria.

(1) Hatchery Description:

Kilo 21 hatchery in Alexandria is the only governmental hatchery at the level of the Republic, which is characterized by the production of larvae from seawater fish of the two types of sea bream and seabass, and it is marketed to all hatcheries inside and outside Alexandria.

The hatchery is located on Alexandria-Matrouh Road, which was established in 1993 with an area of about 7.5 feddan.

The water source is directly from sea water.

The hatchery includes a food production unit represented by (Algae - Artemia - Rotifera).

It includes the mothers unit, egg hatching unit, larvae incubation unit, in addition to the hatchery facilities of a fodder store, an administrative building and a residential building for workers, a room for the electric generator, water pumps, filters, pedals, and a cooling unit.

The production capacity of the hatchery: The hatchery includes 120 mothers and 40 males of bream and seabass with an average weight of 2: 3 kilograms, so that each kilogram of mothers produces a kilogram of eggs equivalent to one million fry.

Providing simulation rooms for the appropriate environmental and atmospheric conditions for production, so that 3 courses are produced throughout the year.

The death rate is estimated at about 90% of hatchlings, about 50% in the larvae, and only about 5% in the fingerlings. Accordingly, the research supposes the marketing of about 75% of the fingerlings and 25% of the larvae. The hatchery is distinguished by the presence of nurseries suitable for raising the fry, and this allows increasing the profits of the hatchery from On the one hand, and on the other hand, increasing the degree of tolerance of fingerlings to the environmental conditions of the breeder, thus reducing his risk.

(2) Costs of establishing, managing and operating a hatchery:

- Investment costs for the marine hatchery:

It is clear from the data in Table (7) that the investment costs of the Kilo 21 hatchery are estimated at about EGP 44 million, including land, buildings, construction, equipment and machinery needed to operate the hatchery.

Table No. (7) the investment costs of the 21 kilo hatchery in Alexandria:

Statement	**Costs (million pounds)**
Earth	2
Buildings and constructions	23
devices and machines	19
Total	**44**

Source: Personal interview from the researcher at the kilo 21 hatchery.

Annual operatinal costs of the marine hatchery:

It is clear from the data in Table (8): that the operational costs of the Kilo 21 hatchery are estimated at about 4.504 million pounds annually, and its items include both the purchase of mothers and males, and its price is estimated at about 180,000 pounds, fodder and its value is estimated at about 196 thousand pounds, while the costs of feeding for larvae are estimated Fingerlings and fingerlings are about EGP 3,834 million, where each million larvae consume about 75 kilos of artemia, in addition to rotifera and artemia support materials. , 27, 15,000 pounds, respectively.

It is clear from the analysis of the hatchery's operational costs that about 88% of the total costs are due to the costs of feeding the larvae (artemia), and the annual wages and salaries.

Table (8): Operational costs of the kilo 21 hatchery in Alexandria:

Statement	**costs** (Thousand pounds)
buy mothers	180
feed	196
Artemia (1125 kg x 3000 pounds)	3375
Rotifer and brine shrimp fortifying materials	63.00
Chemicals for algae	6.00
wages and salaries	630
Electricity and water	36
fuel and diesel	12
maintenance	27
Petty cash	15
Total	4540

Source: Personal interview from the researcher at the kilo 21 hatchery.

(3) Expected Revenues of the Hatchery:

The expected total annual revenue of the marine hatchery is about 88.8 million pounds from the larvae and fingerlings of seabream and seabass, as shown in the data of Table (9), where the average price of larvae for bream and seabass is about 1016.6/ thousand larvae, while the average price of fingerlings is Seabream and seabass, about 8300/ thousand fingerlings.

It is expected to increase the profits of the hatchery by increasing the production in the coming years as the revenues of the hatchery were calculated on the basis of its minimum production of larvae and fingerlings.

Table (9): Annual Revenues of Kilo 21 Hatchery in Alexandria:

Statement	**Average unit price (EGP)**	**Expected annual production (million units)**	**Revenue (million pounds)**
Sea bream and seabass larvae	1016,6/ Thousands larvae	5	5,08
Fingerlings of sea bream and seabass	8300/ Thousands Fingerlings	10	83,00
Total		15	88,80

Source: Personal interview from the researcher at the kilo 21 hatchery.

Fifthly: Financial analysis of the marine hatchery:

In order to derive the financial analysis criteria for the proposed hatchery, the cash flows and outflows were calculated during the project life, according to the following assumptions:

(A) Considering the duration of the project to be 15 years, since the first five years are the establishment of the project and the necessary equipment for it, and the operating costs and profits start from the sixth year of the project. (B) The discount rate on government stocks and bonds (12%) was used as the best alternative opportunity available for investing capital in the community.

(1) Criteria for the financial feasibility of the 21 kilo fish hatchery project for the production of larvae and fingerlings of sea bream and seabass:

It is clear from Table (10) that:
- The net present value of the project amounted to about 450.8 million pounds.
- The internal rate of return reached about 54.3%, which is higher than the interest rate on loans and deposits, which is estimated at 12%; this indicates that the project is economically and financially feasible.
- The ratio of benefits to costs was about 19.05%, as it is greater than one; This indicates that the project is financially viable.

The payback period of the capital is about two years.

Table (10): Financial feasibility criteria for the 21 kilo bream and seabass hatchery:

Criteria	Values
Net present value (million pounds)	450.8 million pounds.
Cost Benefit Ratio (%)	%19.05
Internal rate of return (%)	%54.3
Capital Payback Period	1,8
Present value of costs (million pounds)	556.8 million pounds
Present value of revenue (million pounds)	106.1 million pounds

Source: Compiled and calculated from the results of the costben program analysis.

(2) Risk and Sensitivity Analysis of Internal Rate of Return:

Sensitivity analysis is one of the most important indicators through which it is possible to identify the most sensitive aspects of fluctuations or sudden changes during the various stages of the project.

It is evident from Table 11:

(A) The internal rate of return: The internal rate of return was estimated at 54.3% at a discount rate of 12%, meaning that the profitability of the project amounted to about 54.3 piasters per pound invested, which is higher than the interest rate prevailing in banks, which is about 12%, which is more than The opportunity cost of investing money in banks means that investing money in the field of hatchery project is more financially and economically feasible than investing money in banks.

Internal rate of return decreased to about 51.27% when costs increased by 10% and revenues were stable, while the internal rate of return increased to 60.97% in the case of a decrease in costs by 10% and revenues increased by 10%, while the internal rate of return decreased to 20.29% in the case of an increase in costs by 50% and an increase in revenues by 50%.

(B) Costs rise by 10% with a delay of project revenues by one year, the internal rate of return for the project is about 40.60%, while when costs decrease by 10% with a delay of revenues for two years, 33.41%, while the internal rate of return is estimated at 28.25 % with a delay in project revenues for three years.

(C) Internal rate of return increased to 57.80% when costs were reduced by 10% with stable revenues, while the internal rate of return decreased to 45.71% when costs increased by 10% and project revenues were delayed by one year, costs decreased by 10 With a delay of 37.62% of revenues, the internal rate of return was estimated at 31.84% when the project revenues were delayed by three years.

The above shows that the internal rate of return is higher than the interest rate of banks, which is 12%; this indicates that the project remains financially and economically viable despite the delay in revenues from one to three years.

Table (11): Risk and sensitivity analysis of the internal rate of return for the Kilo 21 hatchery project:

Statement	**Revenues**	Increase 10%	Increase 20%	Increase 50%	Decrease 10%	Decrease 20%	Decrease 50%
costs	54,35	57,47	60,36	67,97	50,95	47,22	32,77
10% Increase	51,27	54,35	57,19	64,68	47,93	44,24	29,88
20% Increase	48,50	51,54	54,34	61,73	45,20	41,54	27,23
50% Increase	41,54	44,49	47,22	54,35	38,31	34,73	20,29
10% Decrease	57,80	60,97	63,91	71,67	54,35	50,56	35,97
20% Decrease	61,73	64,96	67,97	75,89	58,21	54,35	39,56
50% Decrease	78,24	81,77	85,05	93,71	74,42	70,23	54,35

Source: Compiled and calculated from the results of the costben program analysis.

Continued Table No. (11): Sensitivity analysis of the net present value at 12% interest rate:

Statement	Revenue	One year delay	Two years delay	Three years delay
costs	54,35	43,02	35,41	29,95
10% Increase	51,27	40,60	33,41	28,25
20% Increase	48,50	38,42	31,60	26,71
50% Increase	41,54	32,87	26,99	22,75
10% decrease	57,80	45,71	37,62	31,84
20% Decrease	61,73	48,77	40,12	33,96
50% Decrease	78,24	61,43	50,39	42,60
a year delay	————	54,35	43,02	35,41
2 years delay	————	————	54,35	43,02
Three years delay	————	————	————	54,35

Source: Compiled and calculated from the results of the costben program analysis

Table (12) shows the following:

(1) The net present value of fish hatchery revenues amounted to about 150.3 million pounds when costs and revenues are fixed.

(2) When costs are stable and revenues rise by 10%, the net present value is about 170.6 million pounds, while the net present value rises to 190.9 million pounds when revenues rise by 20% with fixed costs, and the net present value rises to 251.9 One million pounds when revenues rise to 50% with fixed costs.

While when costs are stable and revenues decrease by 10%, the net present value decreased by about 129.9 million pounds, and the net present value decreased to 109.6 million pounds when revenues decreased by 20% with the stability of costs, and the net present value decreased to 48.6 million pounds at revenue reduced to 50% with fixed costs.

(C) When costs increase by 10% with stable revenues, the net present value is about 145 million pounds, while the net present value increases when costs increase by 10% and revenues increase by 10%, the net present value is about 165.3 million pounds, while The net present value decreased to about 124.6 million pounds when costs increased by 10% and revenues decreased by 10%, which indicates that the project is more sensitive to rising costs than decreasing revenues.

(D) When the revenues are delayed by one year while the costs and revenues are fixed, the net present value amounted to about 128.5 million pounds, while the net present value decreased by about 109 million pounds when the revenues were delayed two years, while when the revenues were delayed three years, the net present value decreased by 91.7 million EGP, while when costs rise by 10% with a delay in revenues for one year, the net present value is about 123.2 million pounds, and the net present value drops to 103.7 million pounds in the case of delaying revenues by two years, while it decreases to 86.4 million pounds in the case of Three revenue delays. years, while when costs decrease by 10% with delaying revenues by one year, the net present value

is about 133.8 million pounds, and the net present value decreases to 114.3 million pounds in the case of delaying revenues by two years, while it decreases to 97 million pounds in the case of delaying revenues by three years.

Table No. (12): Sensitivity analysis of the net present value at a discount rate of 12%:

Statement	Revenues	Increase 10%	Increase 20%	Increase 50%	Decrease 10%	Decrease 20%	Decrease 50%
costs	150,3	170,6	190,9	251,9	129,9	109,6	48,6
10% Increase	145	165,3	185,6	246,6	124,6	104,3	43,3
20% Increase	139,7	160	180,3	241,3	119,3	99	38
50% Increase	123,7	144,1	164,4	225,4	103,4	83,1	22,1
10% decrease	155,6	175,9	196,2	257,2	135,2	114,9	53,9
20% Decrease	160,9	181,2	201,5	262,5	140,5	120,2	59,2
50% Decrease	176,8	197,1	217,4	278,4	156,4	136,1	75,1

Source: Compiled and calculated from the results of the costben program analysis.

Continued Table (12): Sensitivity analysis of the net present value at 12% interest rate:

Statement	Revenue	One year delay	Two years delay	Three years delay
costs	150,3	128,5	109	91,7
10% Increase	145	123,2	103,7	86,4
20% Increase	139,7	117,9	98,4	81,1
50% Increase	123,7	102	82,5	65,1
10% decrease	155,6	133,8	114,3	97
20% Decrease	160,9	139,1	119,6	102,3
50% Decrease	176,8	155	135,5	118,2
a year delay	————	134,2	114,7	97,3
2 years delay	————	————	119,8	102,4
Three years delay	————	————	————	107

Source: Compiled and calculated from the results of the costben program analysis.

Recommendations:

The research recommends the following:

We must be ready to take all precautions that would protect farms from the expected risks of climate change:

1) Using modern technologies in the recycling of farm water (mechanical and biological filters).

2) Continuous and accurate follow-up of the health status of fish during periods of high temperatures or lack of water supply.

3) Pay attention to adding probiotics or immunostimulants during this period to improve the performance of the fish's immune system.

4) Conducting scientific and practical training courses to rehabilitate technical cadres at the 21 kilo hatchery, in the neighboring countries on the borders of the Mediterranean, which are characterized by marine fish farming as a guide for the development of the fish farming system.

5) Using the full potentials of hatcheries to maintain the production of larvae during non-natural breeding seasons after creating the appropriate environmental conditions for hatching.

6) Apply bio-safety as much as possible inside fish farms.

7) Work to provide the diets of larvae and fish (feed) in appropriate quantities and prices.

8) The necessity of providing transportation at reasonable prices and with appropriate capabilities to transport larvae and fingerlings.

9) Improving the quality of the fish product from its various sources to comply with international requirements.

10) Studying the most important importing markets for seabream and sea bass in order to absorb the surplus production and then increase foreign currencies to contribute to filling the deficit in the balance of payments.

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