An economic study of shrimp and Keeled mullet fish farming in Egypt
(A case study in Damietta Governorate)

Tahany Saleh Mohamed Bayoumi, Ahmed Ibrahem Mohamed Ragab Isawi, Amina Saied Mohamed Foad Ahmed, Dina Abdallah Mohammed Shafik

Agricultural Economics Research Institute - Agricultural Research Center - Egypt
dr_tahany_saleh@yahoo.com

Abstract: The research aimed to study the economics of marine fish farming in Egypt for two types of marine life, shrimp (Crustaceans) and Keeled mullet fish (Mullets nei), using published and unpublished data derived from Government agencies and some concerned websites, and preliminary data derived from questionnaire forms designed for this purpose. In addition to estimating the optimal and most profitable production of both shrimp and steppe fish and estimating the lost income from each of them. Among the most important results of the research: the average shrimp production in Egyptian marine fish farms amounted to about 1.54 million tons with a value of 112.3 million LEs, an annual rate of 0% and 8%, respectively. The average production of fish of the boreal family (including Keeled mullet fish) was 193.2 thousand tons with a value of 4.87 million LEs, and the annual growth of each of them was respectively 5% and 10%. The results showed that there is a discrepancy between the actual production of both shrimp and haddock in the sample farms and between the optimal production and the most profitable production, and therefore there is a lost income that can be obtained when reducing the waste that resulted in the production of each of them separately in the sample farms. The lost income for the optimal civilian production of costs for both shrimp and steppe fish in the sample farms amounted to 363.83 thousand and 106.08 thousand LEs. The lost income for the most profitable production of both shrimp and Keeled mullet at the sample farms amounted to 1.95 million and 1.48 million LEs, respectively .Studying the indicators of the economic efficiency of marine fish farming for shrimp and Keeled mullet fish in Egypt, it was found that the average productivity per feddan of each of them separately amounted to 759.50 kg/Fadden and 980.65 kg/feddan. The net yield of production of each of them was 80.65 thousand LEs/feddan and 95.06 thousand LEs / feddan. The product incentives for both shrimp and herring, respectively, were 67.42% and 77.68%. The break-even price for each of them amounted to 51.31 thousand LEs and 77.68 thousand LEs. The break-even amount was 250 kg/feddan and 220 kg/feddan for both shrimp and haddock, respectively. Studying the problems of shrimp production in the sample farms, the study found that the most important of them are the high costs of Fry, high labor wages, high feed costs and the difficulty of obtaining fry. One of the most important problems of marketing shrimp on the farms of the study sample is the high cost of packaging and preservation, the distance of markets from farms, low selling prices, exploitation of traders, and the speed of shrimp corruption. By studying the problems of the production of Keeled mullet fish in the sample of the study, it turned out that the most important of them are the high losses in fish, the high fuel costs, the high labor wages, the high costs of Fry and the high feed costs. By studying the most important problems of marketing the plains fish produced on farms, a sample study shows that the most important of them are the high fishing wages, low selling prices, distance from the markets from farms, high transportation costs, lack of availability of fishing labor, and exploitation of traders.

Introduction:

Fish is one of the most important sources of animal protein in Egypt, and its monetary value in 2021 amounted to about 67.5 billion LEs, representing 9.1% of the total value of agricultural production in Egypt, which amounted to about 742.5 billion LEs. Fish contributes to filling the nutritional gap of animal protein in Egypt, as the average per capita share of animal protein from animal products and fish in 2021 is about 27.1 grams of protein / Day, which is less than the rate needed to obtain, which ranges from (33 – 40) grams of protein / day. The average per capita amount of animal protein from fish was about 6 g protein/Day, which is about 22.14% of the average per capita

amount of animal protein from animal products and fish.

Fish farming is one of the most important sources of fish production in Egypt, where the production of fish farms in 2021 represents about 73% of the total fish production in Egypt. Coastal fish farming is based on taking advantage of the geographical formations formed by the coastal environment to determine the optimal beach for each area. It is spread on the shores of both the Mediterranean Sea and the Red Sea for the development of fisheries in Egypt.

Damietta Governorate is one of the leading Governorates in this field, along with other Egyptian coastal Governorates located on the Mediterranean coast.

Damietta Governorate is famous for the cultivation of many fish that are accepted by the Egyptian consumer, and the research was interested in studying two important types: shrimp, which is an expensive and nutritionally important crustacean, as it works to feel full and full due to its high protein content, as 90% of the calories in shrimp come from protein and only 10% from fat. It is also rich in many minerals and vitamins, up to 20 types. The research also focused on the study of Keeled mullet fish (which is one of the fish of the boreal family), which is a fish similar to mullet, but it is small in size, it is a good-tasting fish with high nutritional value and is considered a fatty fish, but it is free of cholesterol harmful to human health, and contains many important minerals and vitamins.

The Research problem:

Despite the great importance of both shrimp and Keeled mullet fish (from the boreal family) for the Egyptian consumer, they are expensive due to the low interest in their cultivation compared to other fish that are farmed more, such as tilapia, mullet, Bream, sea bass and others. Despite the importance of fish farming for both shrimp and steppe fish, research studies on the economics of production and marketing of each of them and the study of the problems facing both production and marketing for each species separately are very few, and therefore there is no basis based on the development of these farms and raising their economic efficiency and production.

Objectives:

The study aimed to identify the economies of fish farming for certain types of marine life that have not been sufficiently exposed to scientific research, and the published data on it are also declining. This is through studying the development of fish production in Egypt, the types of fish farms and their area in Egypt in general and Damietta Governorate in particular. The development of the quantity and value of fish farming from fish, shrimp and fish of the boreal family (due to the lack of data on steppe fish). In addition to studying

the indicators of production and economic efficiency of each of them separately, and the problems of production and marketing of each of them separately, in addition to estimating the production functions of each of them and determining the optimal size of both shrimp and steppe fish.

Method and Data sources:

The study relies on the analysis of data and presentation of its findings on the descriptive and quantitative methods represented by percentages, arithmetic mean, relative frequency, and growth rate. And the coefficient of determination. The calculation of the statistical estimation of the production functions of a double logarithm, in the form of (Cobb Douglas), in addition to studying the indicators of economic efficiency and productivity, namely:

1-Net return = total revenue-total costs

2. Gross margin = total revenue-variable costs

3-Profitability of the investor's pound = net return / total costs

4-Average production cost per ton = total costs / total production in tons

5-Net revenue per ton = total revenue / average acre production

6-Product incentive per ton = (net revenue per ton / price per ton) × 100

7-Breakeven point of price = total production costs / quantity of production in tons

8-Breakeven point of quantity = total costs / unit price

The study also relies on two main sources of data, namely the initial data derived from the questionnaire forms that were designed specifically for the study. The fish farming farms for both shrimp and Keeled mullet fish were targeted separately in the study sample in the Dibba triangle in Shatta city, Damietta Governorate. The second two are published and unpublished secondary data from official bodies such as the central Jazz for public mobilization and statistics, the Ministry of Agriculture and land reclamation, the General Authority for the development of fisheries resources, and the lakes and fisheries protection and Development Authority of the presidency of the Council of ministers. In addition to some specialized websites.

Sample of the study:

The sample of the field study was based on an intentional sample from fish farms that follow a semi-intensive breeding system, and raise one type of fish, from marine farms located in the Dibba triangle in Shata, Damietta Governorate, Egypt. The area of the Triangle reached 43 thousand fadden, and the number of fish farms in the Triangle reached 11 thousand farms with an area of 27 thousand fadden, and 25 sightings of fish farms raising two types of marine life each separately, the first raising shrimp and the second

raising steppe fish, and therefore the sample size reached about 50 sightings. The data were collected from the operators of these farms using specially designed questionnaires.

The most important concepts of fish farming:

Fish farming:

It is the breeding of fish of various types, whether freshwater or saltwater fish under controlled conditions and under human control.

The goal of fish farming: it is an effective and fast way to increase the national product of Fish and thus increase the average per capita animal protein and reduce the fish food gap, thereby reducing the food gap It consists of animal protein.

Types of fish farms:

1. **Waste water farms:** These farms derive their water from the drains that drain on lakes such as Manzala, Burlos, Edko and Marriott, so these farms are spread next to the lakes of the end of irrigation.
2. **Freshwater farms:** They are the best types of fish farming, as there are fish that are suitable for this type of breeding, and they also give better growth.
3. **Saltwater farms:** this type of farms is spread on the Mediterranean coast between Lake Manzala and the Mediterranean Sea, north of Lake Burles and the northern coast near Damietta, where this type depends on sea water. This species holds out hope for the development of fish farms in the future.
4. **Drinking water farms:** Drinking water is a mixture of salt and fresh water, and this type of farms is spread in the northern regions on the sides of Manzala, burlus, Edko and Marriott lakes.
5. **Rice field farms:** It is a type of seasonal farms, which is carried out in rice fields, where surplus production is marketed in order to achieve appropriate profitability for farmers.

Fish farming systems: there are several systems, namely:

1. **Regular fish farming:** Fish are raised in earthen ponds that are dug and filled with fresh or salt water. Fish depend on natural food suspended in water (living organisms, fish larvae, nematodes, insects, aquatic plants). The fish density varies (1 – 5) fish / m3 water.
2. **Semi-intensive fish farming:** in which a higher density is obtained without relying on natural food, food or organic waste is introduced to the ponds. The fish density varies (5 – 10) fish/m3 water.
3. **Intensive fish farming:** Aquariums are designed for fish, where water is passed to aquariums with plants that absorb waste until clean water is released to the aquariums, filters may be used to purify the water and attention is paid to the need to introduce oxygen to the aquariums, and food is introduced to the fish and attention must be paid to adding balanced and equipped leeches. The density of fish is (10 – 100) thickness/m3 of water.
4. **High-density fish farming:** these are closed farms that are established in desert or mountainous places in a few areas and using small amounts of water, in which fish are raised throughout the year. They are expensive because they need trained labor, and they also need to use high technology. They are often used in Tilapia farming. It is a high density (200 – 1500) fish/m3 water.

Results:

First: Development of fish production, the area of fish farms, quantity and value:

1- Development of fish production in Egypt according to sources:

The results of Table (1) indicate that the average fish production in Egypt during the period (2005-2021) amounted to about 1472.84 thousand tons, where it reached above about 2010.96 thousand tons in 2020, and reached below in 2005 by about 889.30 thousand tons. The growth rate was about 5%. The average production of fish from the Mediterranean Sea was about 65.10 thousand tons, which amounted to about 4.42% of fish production in Egypt, with a growth rate of about -1%. The average production of fish from the Red Sea was about 47.33 thousand tons, which amounted to about 3.21% of fish production in Egypt, with a growth rate of about -1%. As for the lakes, the average fish production amounted to about 180.93 thousand tons, which amounted to about 12.28% of fish production in Egypt, with a growth rate of about 3%. While the average production of freshwater fish was about 79.64 thousand tons, which amounted to about 5.41% of fish production in Egypt, with a growth rate of about -1%.

The results of Table (1) also show that fish farms produce about 1079.89 thousand tons, amounting to about 73.32% of fish production in Egypt, with a growth rate of about 7%. Finally, rice fields produce about 19.93 thousand tons, which amounted to about 1.35% of fish production in Egypt, with a growth rate of about -7%.

From the above, it is clear that there are many and varied sources of fish production in Egypt, where fish farms come first, followed by lakes, then fresh water, followed by the Mediterranean Sea, then the Red Sea, and finally rice fields. This shows the importance of focusing on fish farms.

2- Development of the area of fish farms in Egypt and Damietta:

The results of Table (2) indicate that fish farms in Egypt and Damietta are divided between Government farms and private farms, and for private farms vary between ownership, rent and temporary farms. The table data shows that the average area of private farms in Egypt during the period (2005-2021) amounted to about 289.17 thousand Fadden, amounting to about 93.36% of the area of nongovernment farms in Egypt, varies between King farms with an average area of about 51.73 thousand fadden, rental farms with an average of about 68.62 thousand fadden, and temporary farms with an average of about 168.82 thousand fadden, and the area of government farms about 20.57 thousand fadden 6.64% of the area of fish farms in Egypt, which amounted to about 309.73 thousand fadden during the period (2005-2021).

It is also clear from the table data that the average area of private farms in Damietta Governorate during the period (2005-2021) amounted to about 57.73 thousand fadden, which amounted to about 19.94% of the same in Egypt, and the number of fish farming farms amounted to rent with an average of about 28.56 thousand fadden, and temporary farms with an average of about 56.61 thousand fadden, and The area of government Farms is about 1.87 thousand fadden, which amounted to about 3.22% of the area of fish farms in Damietta, which amounted to about 58 thousand fadden during the period (2005-2021). From the above, the importance of Damietta Governorate is clear, where it represents about 18.82% of the area of fish farms in Egypt, and the importance of private farms is also clear, where it represents about 19.94%.

Table (1): The evolution of the relative distribution of fish production according to fisheries in Egypt (in thousand tons) during the period (2005-2021):

Years	Total fish production (Thousand tons)	The Mediterranean (Thousand tons)	(%)	Red Sea (thousand tons)	(%)	Lakes (Thousand tons)	(%)	Fresh water (Thousand tons)	(%)	Fish farms (Thousand tons)	(%)	Rice fields (Thousand tons)	(%)
2005	889.3	56.7	6.38	50.7	5.7	158.6	17.84	83.5	9.39	522.1	58.72	17.6	1.98
2006	970.9	72.7	7.49	46.9	4.83	151.3	15.58	105	10.8	589.4	60.71	5.6	0.58
2007	1008	83.8	8.31	47	4.66	144	14.29	97.7	9.69	630.2	62.52	5.3	0.53
2008	1067.6	88.9	8.33	47.4	4.44	157.8	14.78	79.7	7.47	665.9	62.37	27.9	2.61
2009	1092.9	78.8	7.21	49	4.48	172.3	15.77	87.3	7.99	667.8	61.1	37.7	3.45
2010	1304.8	77.4	5.93	44	3.37	179.2	13.73	84.6	6.48	890.4	68.24	29.2	2.24
2011	1362.2	77.8	5.71	44.5	3.27	163.4	12	89.7	6.58	951.7	69.86	35.1	2.58
2012	1372	69.3	5.05	45	3.28	173.4	12.64	66.6	4.85	983.2	71.66	34.5	2.51
2013	1454.4	63.1	4.34	43.6	3	182.5	12.55	67.7	4.65	1063.4	73.12	34.1	2.34
2014	1481.9	62.7	4.23	45	3.04	170.9	11.53	66.1	4.46	1103.1	74.44	34	2.29
2015	1518.9	57.6	3.79	45.3	2.98	171.5	11.29	69.7	4.59	1157.3	76.19	17.5	1.15
2016	1706.3	54	3.16	49.7	2.91	158.5	9.29	73.5	4.31	1357.1	79.53	13.5	0.79
2017	1822.8	58.9	3.23	50.8	2.79	183.5	10.07	77.7	4.26	1444.1	79.23	7.7	0.42
2018	1934.7	56.7	2.93	48	2.48	194.8	10.07	73.7	3.81	1549.7	80.1	11.8	0.61
2019	2039	48	2.35	50.9	2.5	220.7	10.82	77.4	3.8	1626.1	79.75	15.9	0.78
2020	2010.6	49.9	2.48	51.5	2.56	237.8	11.83	79.5	3.95	1585.9	78.88	5.9	0.29
2021	2001.96	50.35	2.5	45.24	2.5	255.64	12.8	74.51	3.7	1570.66	78.4	5.53	0.3
Average	1472.84	65.1	4.42	47.33	3.21	180.93	12.28	79.64	5.41	1079.89	73.32	19.93	1.35
Growth rate	5%	-1%		-1%		3%		-1%		7%		-7%	-

Source: General Authority for the development of Fisheries. Annual book of fishery statistics. Scattered numbers.

3- Development of the quantity and value of fish, shrimp and steppe farming:

The results of Table (3) indicate that the amount of production from fish farming amounted to about 1086.14 thousand tons during the period (2005-2021) with a value of about 20.77 billion LEs, the highest amount reached about 1626.06 thousand tons in 2019, with a value of about 47.63 billion LEs, and the lowest amount reached about 522.14 thousand tons in 2005 with a value of about 4.49 billion LEs, and the growth rate reached about 7% fish farming, and about 16% of the value of fish farming.

The results of the table also show that the amount of shrimp production amounted to about 1.54 thousand tons during the period (2005-2021) with a value of about 112.32 million LEs, the highest amount reached about 4.24 thousand tons in 2014, with a value of about 399.71 million LEs, and the lowest amount reached about 10 tons in 2015 with a value of about 720 thousand LEs, and the growth rate reached about 8% for the value of shrimp.

Table (2): the area of fish farms in Egypt and Damietta Governorate (in Thousand Fadden) during the period (2005-2021).

Years	Egypt						Damietta							
	nongovernmental farms			total	gov	The total		nongovernmental farms		total	(%)	gov	total	(%)
	The owner farm	Rent	Temporary					Rent	Temporary					
2005	61.31	47.97	138.08	247.35	17.24	264.59	-	23.32	35	58.32	23.58	1.85	60.17	22.74
2006	65.89	99.82	152.76	318.46	16.84	335.3	-	23.78	35	58.78	26.94	1.85	60.62	18.08
2007	60.07	104.55	178.85	343.47	16.81	360.28	-	23.59	35	58.59	17.06	1.85	60.44	16.78
2008	54.65	107.99	179.02	341.66	17.72	359.37	-	26.42	35	61.42	17.98	1.85	63.27	17.61
2009	46.57	93.18	175.62	315.37	16.83	332.2	-	26.97	35	61.97	19.65	1.87	63.4	19.08
2010	38.49	78.38	172.21	289.08	15.95	305.03	-	28	35	63	21.79	1.86	64.86	21.26
2011	39.95	59.08	173.95	272.97	12.87	285.84	-	28	35	63	23.08	1.87	64.87	22.69
2012	39.81	60.26	173.12	273.19	14.21	287.41	-	28	35	63	23.06	1.86	64.86	22.57
2013	47.3	53.22	174.68	275.2	17.42	292.62	-	28.28	35	63.28	22.99	1.86	65.14	22.26
2014	56.45	54.49	171.45	282.4	16.02	298.43	-	29.1	35	64.1	22.7	1.86	65.96	22.1
2015	55.91	55.53	186.15	297.6	12.75	310.35	-	30.09	35	65.09	21.87	1.86	66.95	21.57
2016	54.95	56.77	184.19	295.91	24.89	320.8	-	31.19	35	66.19	22.37	1.86	68.05	21.21
2017	54.93	57.14	170.22	282.29	20.36	302.65	-	31.78	9	40.78	14.45	1.9	42.68	14.1
2018	55.25	56.83	174.94	287.02	20.22	307.24	-	31.78	9	40.78	14.21	1.9	42.68	13.89
2019	55.88	58.9	162.25	277.03	18.19	295.21	-	31.86	30.8	62.66	22.62	1.9	64.56	21.87
2020	48.59	61.06	155.63	265.28	41.83	307.11	-	31.73	-	31.73	11.96	1.9	33.63	10.95
2021	43.38	61.31	146.85	251.54	49.5	301.04	-	31.71	-	31.71	12.61	1.9	33.63	11.17
Average	51.73	68.62	168.82	289.17	20.57	309.73	-	28.56	27.58	57.73	19.94	1.87	57.99	18.82
Growth rate	-2%	1%	0%	0%	6%	1%	-	2%	-1%	-4%		0%	-3%	

Source: Central agency for public mobilization and statistics. Annual bulletin of fish production statistics, sporadic number.

Table (3): Quantity and value of fish farming, shrimp and boreal family in Egypt during the period (2005-2021)

The years	Fish farming		Shrimp		Mullet fish	
	Quantity (Thousand tons)	Value (One billion LEs)	Quantity (Thousand tons)	Value (One billion LEs)	Quantity (Thousand tons)	Value (One billion LEs)
2005	522.14	4.49	3.3	206.12	156.44	1.77
2006	586.45	5.33	0.31	34.04	231.6	2.66
2007	630.22	6.54	0.09	5.63	252.51	3.41
2008	665.2	6.56	0.13	5.62	209.31	3.25
2009	777.78	8.05	0.46	19.14	162.67	2.55
2010	890.36	9.54	0.79	32.65	116.03	1.84
2011	951.71	11.31	0.77	31.02	114	2.28
2012	983.2	11.81	1.11	47.65	129.65	2.51
2013	1063.41	13.94	5.86	275.52	116.15	2.09
2014	1103.11	15.87	7.24	399.71	119.65	2.58
2015	1157.29	16.9	0.01	0.72	157.18	0.69
2016	1357.13	24.92	0.1	8.59	153.78	3.61
2017	1444.11	33.92	0.14	13.61	210.21	6.9
2018	1549.66	37.51	0.16	25.25	242.07	8.72
2019	1626.06	47.63	0.12	24.44	243.97	9.64
2020	1585.95	47.83	2.15	44.05	317.81	12.67
2021	1570.66	50.91	3.43	735.73	351.2	15.6
Average	1086.14	20.77	1.54	112.32	193.19	4.87
Growth rate	7%	16%	-	8%	5%	15%

Source: General Authority for the development of Fisheries. Annual book of fishery statistics. Scattered numbers.

The results of Table (3) indicate that the amount of production from The family of mullet fish, to which keeled mullet belongs, because it does not have separate data, amounted to about 193.19 thousand tons during the period (2005-2021) with a value of about 4.87 billion LEs, the highest amount reached about 15.60 thousand tons in 2021, with a value of about 15.60 billion LEs, and the lowest amount reached about 114 thousand tons in 2011 with a value of about 2.28 billion LEs, and the growth rate reached about 5%

production from The family of mullet fish, and about 15% of the value of production from The family of mullet fish.

Second: Economics of production and marketing of shrimp farms sample study:

1- **Socio-economic characteristics and characteristics of shrimp farmers:**

The data of Table (4) indicate that as for the marital status, about 74.07% of the respondents are married, and about 25.93% are not married. As for the educational situation, about 69.23% are uneducated, while about 30.77% are literate. The average age of the respondents was about 55.2 years, with an average of 26.5 years of experience. As for the economic characteristics, about 100% of the farms in the sample are private farms, all owned, and all farms operate a semi-intensive farming system. The data of the table also indicate that the average cycle duration is about 4.63 months, and the average farm area is about 8.15 fadden. The average productivity of the farm was about 6188.5 kg.

Table (4): Socio and Economic characteristics of shrimp farmers in the field study sample during 2023.

Statement		Unity	Value	Statement		Unity	Value
Social status	**Married**	%	74.07	**Farm ownership**	**Owner farm**	%	-
	Not married	%	25.93		**Rent farm**	%	100
	Total	%	100		**Total**	%	100
Educational status	**Educated**	%	30.77	**Culture system**	**Ordinary**	%	-
	Uneducated	%	69.23		**Intensive**	%	0
	Total	%	100		**Semi-intensive**	%	100
Age in years		Year	55.2		**total**	%	100
Number of years of experience		Year	26.5	**Average course duration**		month	4.63
Type of farms	**Governmental farms**	%	0	**Average farm area**		Fadden	8.15
	nongovernmental farms	%	100	**Average farm productivity**		ton	6188.5
	Tota	%	100				

Source: Data of the questionnaire form for 2022

2- **Items of farm processing and shrimp production costs in the study sample:**

From Table (5) it is clear that the average total costs of shrimp production in the study sample in 2022 amounted to about 317.6 thousand LEs, and the average fixed costs amounted to about 23 thousand LEs, representing about 7.25% of the average total costs of shrimp in the study sample, while the average variable costs amounted to about 294.6 thousand LEs, amounting to about 92.8%.

By studying the average costs per acre in fish farms in the study sample, it turned out that they amounted to about 39 thousand LEs, and the average fixed costs amounted to about 2.82 thousand LEs/acre, while the average variable costs amounted to about 36.15 thousand LEs

Table (5): The structure of cost items for shrimp production in thousand LEs according to the field study sample during 2022.

	Statement	average sample	per fadden	(%)[1]	(%)[2]
Fixed costs	**Land preparation**	3.62	0.44	15.71	1.14
	Depreciation of machinery	2.16	0.27	9.39	0.68
	Installations	2.35	0.29	10.19	0.74
	Land rent	13.89	1.7	60.36	4.37
	Licenses for farms	1.02	0.12	4.34	0.31
	Total fixed costs	23.02	2.82	100	7.25
variable costs	**Costs for Fry and Fingerlings**	150.01	18.41	50.58	47.2
	Feed costs	104.8	12.85	35.58	33
	Machine maintenance costs	2.75	0.34	0.93	0.87
	Fuel costs	17.27	2.12	5.86	5.44
	Veterinary care costs	1.38	0.17	0.47	0.44
	Transportation costs	1.67	0.21	0.57	0.53
	Fixed labor and harvesting costs	16.69	2.05	5.67	5.26
	Total variable costs	294.57	36.15	100	92.8
	Total costs	317.59	38.97	-	100

[1] **Percentage of fixed costs, or variable costs.** [2] **Percentage of total costs**

Source: Data of the questionnaire form for 2022.

3- Maximize the entry of shrimp farmers using the overall cost averages curriculum:

Using field data on the average production costs of a ton of shrimp in LEs as a subordinate variable and the average production of shrimp in tons as a separate variable, the average production costs of a ton of shrimp in LEs (function No. 1) and the marginal costs of producing a ton of shrimp in the following two LEs were estimated:

$$ATC = 56.433 - 4.289 X + 0.251 X^2$$
......................(1)
    (12.88)** (-2.91)** (2.26)*
        $\acute{R}^2 = 0.33$ F = (7.11)**

$$MC = 56.433 - 8.578 X + 0.753 X^2 .... (2)$$
              ** Moral at 0.01   * Moral at 0.05

The results of the equation (1) and figure (1) show that the quadratic picture is consistent with economic logic, where the function's morale was established at a morale level of 0.01, and the determination factor was estimated at about 0.33. This means that changes in the volume of production explain about 33% of the change in costs and the rest is due to other unexamined factors. F was estimated to be 7.11, which is at 0.01.

Estimate the size of the civil optimal production of the cost of the function, which we get by equating the threshold costs with the average costs, estimated at 8.50 tons. That is, the lost income for optimal production is about 363.83 thousand LEs.

The maximum profit output of the function is estimated to be equal to the threshold costs and estimated at 18.55 tons. That is, the lost income for the most profitable production is about Pound 19,46.7 thousand.
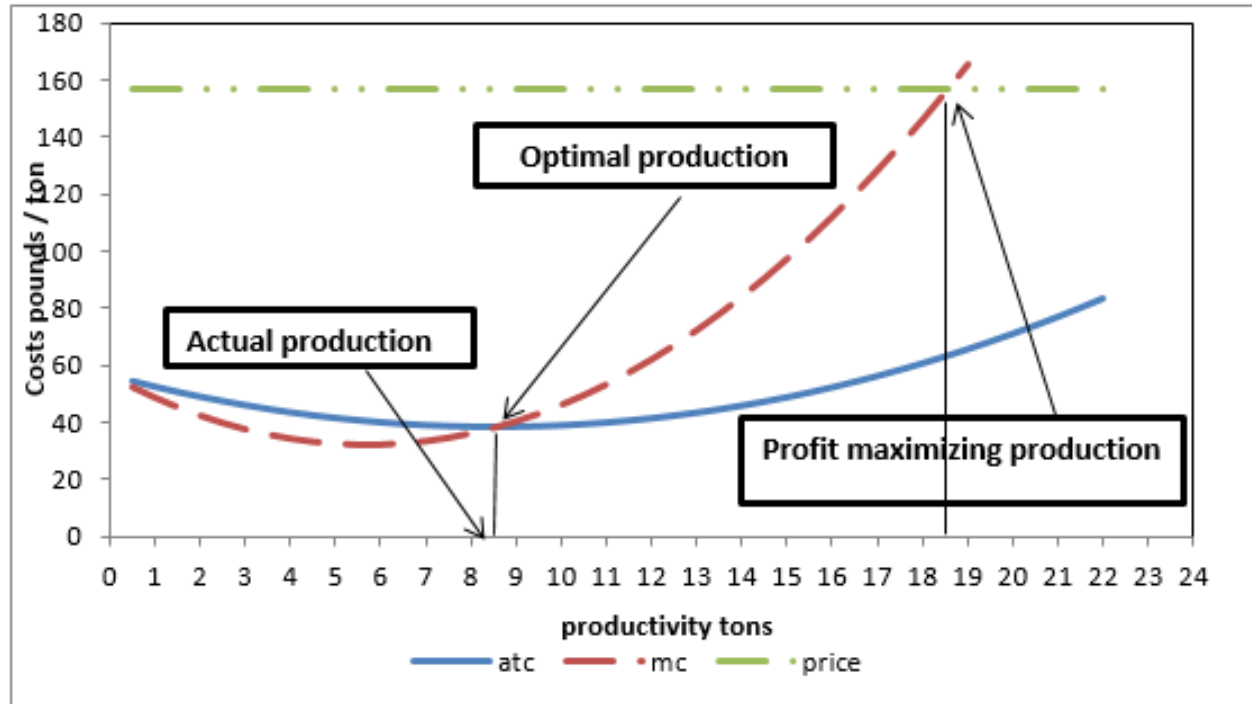
Figure (1): Curves of average total costs, marginal costs, and farm price for shrimp producers in the field study sample.
Source: field study sample 2022.

4- **Indicators of the productive and economic efficiency of shrimp farming in the sample of the study:**

The results of Table (6) indicate that the average shrimp production amounted to about 6.19 tons for the average sample, while the average price of a ton of shrimp amounted to about 157.56 thousand LEs, that is, the total revenue for the sale of shrimp as an average for the study sample amounted to about 974.93 thousand LEs, fixed costs amounted to about 23.02 thousand LEs, variable costs amounted to about 294.57 thousand LEs, total costs amounted to about 317.59 thousand LEs, net return amounted to about 657.34 thousand LEs, and the gross margin is about 680.36 thousand LEs, and the profitability of the invested pound was about 2.23 LEs, while the ratio of revenue to total costs was about 3.07, and the ratio of revenue to variable costs was about 3.31, while net income was The product incentive was about 67.42%, the break-even point for the price was about 51.31 thousand LEs, and the break-even point for the quantity was about 2.02 tons.

The results of the table also indicate that the average shrimp production amounted to about 759.32 kilograms per fadden, and the average price of a ton of shrimp amounted to about 157.50 thousand LEs, that is, the total revenue for the sale of shrimp per acre amounted to about 119.59 thousand LEs, while fixed costs amounted to about 2.82 thousand LEs, variable costs amounted to about 36.15 thousand LEs, total costs amounted to about 38.97 thousand LEs, net yield amounted to about 80.65 thousand LEs, gross margin 83.47 thousand LEs, and the profitability of the invested pound amounted to about 2.23 LEs.

5- **Shrimp marketing outlets in the study sample:**

The data of Table (7) indicate the multiplicity and diversity of shrimp sales and marketing outlets in the field study sample, where the top comes the sale to wholesalers by about 54.05%, followed by the sale to retailers by about 32.43%, and finally the sale to the consumer by about 13.52%.

Table (6): Indicators of production and economic efficiency of shrimp production in the study sample In 2022.

The index	Unity	Sample average	Per Fadden
Average shrimp production	Kg	6190	759.5
Average price per ton	Thousand LEs	157.50	157.50
Shrimp sales revenue	Thousand LEs	974.93	129.62
Fixed costs	Thousand LEs	23.02	2.82
Variable costs	Thousand LEs	294.57	36.15
Total costs	Thousand LEs	317.59	38.97
Net return	Thousand LEs	657.34	80.65
Gross margin	Thousand LEs	680.36	83.49
Profitability of the invested pound	LE	2.03	2.03
The ratio of revenues to total costs	-	3.07	3.07
The ratio of revenue to variable costs	-	3.31	3.31
Average cost of production per ton	Thousand LEs	51.31	51.31
Net income per tonne	Thousand LEs	106.19	106.22
Product incentive	%	67.42	67.44
Break-even price	Thousand LEs	51.31	51.28
The breakeven point of the quantity	ton	2.02	0.25

Source: field study sample 2022.

Table (7): shrimp marketing outlets by study sample IN 2022.

Statement	Relative frequency (%)
Sale to wholesaler	54.05
Selling to a retailer	32.43
Selling to the consumer	13.52
Sentence	100

Source: field study sample 2022.

Third: Problems of shrimp production and marketing according to the opinions of breeders of the study sample:

1- Production problems: The data of Table (8) indicate the multiplicity and diversity of farmers ' opinions regarding the problems of shrimp production in the field study sample, where the first is the increase in Fry costs by about 25.74%, followed by an increase in labor wages by about 23.76%, the increase in feed costs by about 18.81%, then the difficulty of obtaining Fry by about 16.83%, and finally the increase in fuel costs by about 18.85%.

2- Shrimp marketing problems: the data of Table (8) indicate the multiplicity and diversity of farmers ' opinions regarding the problems of shrimp marketing in the field study sample, where the first comes the high cost of packaging and preservation by about 29.31%, followed by the distance of markets from farms by about 24.14%, the decline in selling prices by about 22.41%, then the exploitation of traders by about 18.96%, the speed of shrimp corruption by about 3.45%, and finally the decrease in the marketed quantity by about 1.72%.

Table (8): Problems of production and marketing of shrimp in the study sample in 2022.

	Production problems	Relative frequency (%)		Marketing problems	Relative frequency (%)
1	High feed costs	18.81	1	Exploitation of traders	18.96
2	Difficulty getting fry	16.83	2	Distance of markets from farms	24.14
3	High fry costs	25.74	3	The speed of shrimp spoilage	3.45
4	Rising fuel costs	14.85	4	Low selling prices	22.41
5	Rising labor wages	23.76	5	High packaging and preservation costs	29.31
	Total	100	6	Reduced quantity marketed	1.72
				Total	100

Source: field study sample 2022.

Fourth: Economics of production and marketing of Keeled mullet fish in farms sample study:

1- Socio-economic characteristics and characteristics of shrimp farmers:

The data of Table (9) indicate that as for the marital status, about 64% of the respondents are married, and about 36% are not married. As for the educational situation, about 60% are uneducated, while about 40% are literate. The average age of the respondents was about 53.1 years, with an average of 26.3 years of experience. As for the economic characteristics, about 100% of the farms in the sample are private farms, all owned, and all farms operate a semi-intensive farming system. The data of the table also indicate that the average cycle duration is about 8.96 months, and the average farm area is about 6.20 fadden. The average productivity of the farm was about 6080 kg.

Table (9): Socio and Economic characteristics of Keeled mullet farmers in the field study sample during 2023.

Statement		Unity	Value	Statement		Unity	Value
Social status	**Married**	**%**	**64**	**Farm ownership**	**Owner farm**	**%**	**-**
	Not married	**%**	**36**		**Rent farm**	**%**	**100**
	Total	**%**	**100**		**Total**	**%**	**100**
Educational status	**Educated**	**%**	**40**	**Culture system**	**Ordinary**	**%**	**-**
	Uneducated	**%**	**60**		**Intensive**	**%**	**0**
	Total	**%**	**100**		**Semi-intensive**	**%**	**100**
Age in years		**Year**	**53.1**		**total**	**%**	**100**
Number of years of experience		**Year**	**26.3**	**Average course duration**		month	**8.96**
Type of farms	**Governmental farms**	**%**	0	**Average farm area**		**Fadden**	**6.20**
	nongovernmental farms	**%**	100	**Average farm productivity**		**Ton**	**6080**
	Tota	**%**	**100**				

Source: Data of the questionnaire form for 2022

2- Items of farm processing and shrimp production costs in the study sample:

From Table (10) it is clear that the average total costs of shrimp production in the study sample in 2022 amounted to about 169.34 thousand LEs, and the average fixed costs amounted to about 19.07 thousand LEs, representing about 11.26% of the average total costs of shrimp in the study sample, while the average variable costs amounted to about 150.27 thousand LEs, amounting to about 88.74%.

By studying the fixed costs in the study sample, it was found that they increased to reach the maximum in the cost of rent and amounted to about 10.78 thousand LEs, representing about 56.53% of the total fixed costs in the study sample, followed by the costs of processing the land on which the farm is planned and amounted to about 3.96 thousand LEs at about 20.77%, followed by the depreciation costs of machinery and amounted to about 2.11 thousand LEs at about 11%, and 430 LEs, an increase of about 2.25%, from the average fixed costs of Sahel fish farms in the study sample for the year 2022.

By studying the variable costs of fish farming farms for the Keeled mullet fish in the study sample, it was found that they increased to the maximum in the cost of purchasing feed needed to feed the Keeled mullet fish and averaged about 79.72 thousand LEs, representing about 53% of the total variable costs in the study sample, followed by labor costs, averaging about 33.16 thousand LEs, about 22%, followed by the cost of buying Fry and Fingerlings, averaging about 28 thousand LEs, about 18.64%, and the average cost of necessary veterinary care in the study sample was about 1.45 thousand LEs, a percentage of about 0.96%, This is from the average variable costs of fish farming farms for Keeled mullet fish in the study sample for the year 2022.

By studying the average costs per acre in fish farms in the study sample, it turned out that they amounted to about 27.32 thousand LEs, and the average fixed costs amounted to about 3.08 thousand LEs/acre, while the average variable costs amounted to about 24.24 thousand LEs.

Table (10): the structure of cost items for keeled mullet production in thousand LEs according to the field study sample during 2022.

	Statement	average sample	per fadden	(%)[1]	(%)[2]
Fixed Costs	Land preparation	3.96	0.64	20.77	2.34
	Depreciation of machinery	2.11	0.34	11.06	1.25
	Installations	1.79	0.29	9.39	1.06
	Land rent	10.78	1.74	56.53	6.37
	Licenses for farms	0.43	0.07	2.25	0.25
	Total fixed costs	19.07	3.08	100	11.26
variable costs	Costs for Fry and Fingerlings	28.01	4.52	18.64	16.54
	Feed costs	79.72	12.86	53.05	47.08
	Machine maintenance costs	2.13	0.34	1.42	1.26
	Fuel costs	4.19	0.68	2.79	2.47
	Veterinary care costs	1.45	0.23	0.96	0.86
	Transportation costs	1.61	0.26	1.07	0.95
	Fixed labor and harvesting costs	33.16	5.35	22.07	19.58
	Total variable costs	150.27	24.24	100	88.74
	Total costs	169.34	27.32	-	100

[1] **Percentage of fixed costs, or variable costs.** [2] **Percentage of total costs**
Source: Data of the questionnaire form for 2022

3- Maximize the entry of CBD farmers using the total cost averages curriculum:

Using field data on the average production costs of a ton of CPP as a subordinate variable and the average CPP per ton as a separate variable, the average production costs of a ton of CPP (CPP 1) and the marginal costs of producing a ton of CPP as follows:

$$ATC = 65.18 - 9.679X + 0.633 X^2 \dots\dots\dots\dots\dots\ (3)$$
$$(8.78)** \quad (-3.37)** \quad (2.52)*$$
$$\acute{R}^2 = 0.44 \qquad F = (10.43)**$$
$$MC = 65.18 - 19.358 X + 1.899 X^2 \dots\dots\ (4)$$
$$**Moral\ at\ 0.01\ *\qquad Moral\ at\ 0.05$$

The results of equation No. (3) and figure No. (2) show that the quadratic picture is consistent with economic logic, where the function's morale was established at a moral level of 0.01, and the determinant coefficient was estimated at 0.44. This means that changes in the volume of production explain about 44% of the change in costs and the rest is due to other unexamined factors. F is estimated to be around 10.43 and is in spirits at a level of 0.01.

Estimate the size of the civil optimal production of the cost of the function, which we get by equating the threshold costs with the average costs, estimated at 7.65 tons. That is, the lost income for optimal production is about 106.08 thousand LEs.

The maximum profit output of the function is estimated to be 12.64 tons. That is, the lost income for the most profitable production is about Pound 1,477.6 thousand.
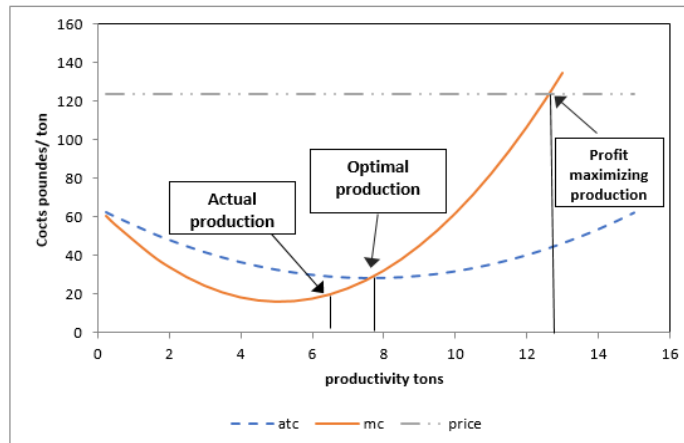

Figure (2): Curves of average total costs, marginal costs, and farm price for Keeled mullet producers in the field study sample.
Source: field study sample in 2022

3- Indicators of the economic efficiency of fish farming for keeled mullet fish in the study sample:

The results of Table (11) indicate that the average production of keeled mullet fish amounted to about 6080 Kg for the average sample, while the average price of keeled mullet fish was about 124.80 thousand LEs, that is, the total revenue for the sale of keeled mullet as an average for the study sample amounted to about 758.78 thousand LEs, fixed costs amounted to about 19.07 thousand LEs, variable costs amounted to about 150.27 thousand LEs, total costs amounted to about EGP 169.34 thousand, the net return was about EGP 589.44 thousand, the gross margin was about EGP 608.51 thousand, the profitability of the pound invested was about EGP 3.48, while the ratio of revenue to total costs was about 4.48, the ratio of revenue to variable costs was about 5.05, and the

average cost per ton was about 27.85 thousand LEs, while the net revenue per ton was about 96.95 thousand LEs, the product incentive was about 77.68%, the break-even point for the price was about 27.85 thousand LEs, and the break-even point for the quantity was about 1.36 tons.

The results of the table also indicate that the average production of keeled mullet fish amounted to about 980.65 kilograms per acre, and the average price of a ton of keeled mullet fish amounted to about 124.80 thousand LEs, that is, the total revenue for the sale of keeled mullet per acre amounted to about 122.38 thousand LEs, while fixed costs amounted to about 3.08 thousand LEs, variable costs amounted to about 24.24 thousand LEs, total costs amounted to about 27.32 thousand LEs, net return for the total is about 98.14 thousand LEs, and the profitability of the invested pound amounted to about 3.48 LEs.

Table (11): Indicators of production and economic efficiency of keeled mullet production in the study sample In 2022.

The index	Unity	Sample average	Per Fadden
Average keeled mullet production	Kg	6080	980.65
Average price per ton	Thousand LEs	124.80	124.80
Keeled mullet sales revenue	Thousand LEs	758.78	122.38
Fixed costs	Thousand LEs	19.07	3.08
Variable costs	Thousand LEs	150.27	24.24
Total costs	Thousand LEs	169.34	27.32
Net return	Thousand LEs	589.44	95.06
Gross margin	Thousand LEs	608.51	98.14
Profitability of the invested pound	LE	3.48	3.48
The ratio of revenues to total costs	-	4.48	4.48
The ratio of revenue to variable costs	-	5.05	5.05
Average cost of production per ton	Thousand LEs	27.85	27.85
Net income per tone	Thousand LEs	96.95	96.95
Product incentive	%	77.68	77.68
Break-even price	Thousand LEs	27.8	27.85
The breakeven point of the quantity	ton	1.36	0.22

Source: field study sample 2022.

4- Keeled mullet marketing outlets in the study sample:

The data of Table (12) indicate the multiplicity and diversity of keeled mullet sales and marketing

outlets in the field study sample, where the top comes the sale to wholesalers by about 68.75%, followed by the sale to retailers by about 31.25%, and finally the sale to the consumer by about 13.52%.

Table (12): Keeled mullet marketing outlets by study sample in 2022.

Statement	Relative frequency (%)
Sale to wholesaler	54.05
Selling to a retailer	32.43
Selling to the consumer	13.52
Sentence	100

Source: field study sample 2022.

Third: Problems of keeled mullet production and marketing according to the opinions of breeders of the study sample:

1- Production problems:

The data of Table (13) indicate the multiplicity and diversity of farmers ' opinions regarding the problems of keeled mullet production in the field study sample, where the first is the increase in Fry costs by about 25.74%, followed by an increase in labor wages by about 23.76%, the increase in feed costs by about 18.81%, then the difficulty of obtaining Fry by about 16.83%, and finally the increase in fuel costs by about 18.85%.

2- Keeled mullet marketing problems:

The data of Table (13) indicate the multiplicity and diversity of farmers ' opinions regarding the problems of keeled mullet marketing in the field study sample, where the first comes the high cost of packaging and preservation by about 29.31%, followed by the distance of markets from farms by about 24.14%, the decline in selling prices by about 22.41%, then the exploitation of traders by about 18.96%, the speed of keeled mullet corruption by about 3.45%, and finally the decrease in the marketed quantity by about 1.72%.

Table (13): problems of production and marketing of keeled mullet in the study sample in 2022.

	Production problems	Relative frequency (%)		Marketing problems	Relative frequency (%)
1	High feed costs	10.95	1	Lack of availability of fishing labor	14.67
2	High loss of fish	15.33	2	Exploitation of traders	12.00
3	Difficulty getting feed	5.11	3	Number Cheats	5.33
4	Feed cheats	8.03	4	High fishing wages	24.00
5	Unavailability of fertilizers	7.30	5	Distance of markets from farms	20.00
6	Difficulty of availability of Fry	2.92	6	Low selling prices	21.34
7	High fry costs	12.41	7	High transportation costs	17.33
8	Rising fuel costs	13.87	8		
9	Lack of availability of Labor	8.03			
10	Rising labor wages	13.14			
	Total	100		Total	100

Source: field study sample in 2022.

Recommendations

The study recommends the following:

1. It is necessary to provide the necessary production requirements for fish farming, especially feed At Reasonable Prices.
2. A database must be provided for all fish destined in Egypt, indicating the quantities produced annually, their monetary value and their importance for internal and external markets.
3. It is necessary to pay attention to fish farming, especially marine, because of its great importance in the production of important marine fish for the consumer.
4. It is necessary to pay attention to intensive and semi-intensive marine fish farming systems and replace them with intensive systems to provide the necessary care for fish and reduce the waste already occurring in semi-intensive systems and thus increase production, which clearly contributes to reducing the protein gap in Egypt.
5. The establishment of specialized institutes in training the technical labor necessary for fish farming in Egypt.

References

[1]. The central agency for public mobilization and statistics, the annual bulletin of fish production statistics, sporadic numbers.
[2]. The General Authority for the development of Fisheries. Annual book of fishery statistics. Scattered numbers.
[3]. The General Authority for the development of Fisheries, the General Administration for development and extension, Bulletin of marine shrimp farming, Bulletin No. (32), 2008.

［4］.   The General Authority for the development of Fisheries, the General Administration for development and extension, Bulletin of marine fish farming, bulletin no. (3946), 2010.

［5］.   Ministry of Agriculture and land reclamation, economic affairs sector, Agricultural Income Bulletin, 2021.

［6］.   Ministry of Agriculture and land reclamation, Economic Affairs Sector, food balance bulletin, 2021.

［7］.   Presidency of the Council of ministers, lakes and fisheries protection and Development Authority, unpublished secondary data, 2023.

［8］.   Reham Hamdy Hegazy El Morsy: Economics of fish farming in Egypt, master thesis, Department of Agricultural Economics, Faculty of Agriculture, Zagazig University, 2012.

［9］.   Saber Mustafa Mohamed Mahmoud: Economics of fish farming in the Arab Republic of Egypt, PhD thesis, Department of Agricultural Economics, Faculty of Agriculture, Al-Azhar University, 2004.

8/2/2023