

Analytical and Economic Investigations on Marine Crustaceans in Egyptian Fisheries

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Abstract: This research aimed to study the marine crustaceans (shrimp and crab) in the Egyptian fisheries during the period from 1999-2006 to investigate its relative importance, annual gross rate of its production, forecasting and the effect of its prices on the production. The economic importance of crustaceans lies in its role as a nutritional and commercial tourist and recreational food pattern in Egypt. It represents 1.6% of the total Egyptian fish product and about 7.8% of the Egyptian fish income. The research was depended on the data published by general Authority for fish resources and development (GAFRD) during the period 1990-2006 and also on the relevant Arab and foreign references. The research was depended on the descriptive economic analysis and statistical analysis to release the purpose of the research. It has been shown from the economical and the statistical analysis during the period from 1990 to 2006 that: the rate of the annual growth in the quantity of catches of shrimp is about 3% compared with 13% calculated for crab, the wholesale prices of marine crustaceans is increasing year by year, since the rate of increasing price of shrimp per year is about 10.9%, compared with 8.3% for crab, the price of marine crustaceans are directly proportional with its product, whereas the change in its prices by 1% leads to an accompanied change in the quantities of catches by 0.4% for shrimp and 2.4% for crab, which explain the growing demand on it as tourist goods and the forecasted catch of shrimp by 2012 will reach about 11.9 thousand ton compared with 15.0 thousand ton for crab. Also, it is predicted that the price will augment 2.4 times more than that of 2006. The risk of the investments in the marine crustaceans fisheries is a little due to the high investment incentives which referred by the high value of the product, as well as environmental and food incentives.

Key words: Crustaceans % Wholesale prices % Growth rate % Investment % Regression models % Forecasting % The non equality coefficient (U-Theil)

INTRODUCTION

The marine crustaceans (shrimp and crab) are characterized by their high nutritional and economic values, therefore it occupies an important class in the marine fish product of Egyptian fisheries, whereas shrimp contains the highest ratio of animal protein (~ 22.7%) as compared with Bass carouse fish (~ 20.6%), chicken (~ 19.8%) and veel (~ 19.1%). Also, crab and shrimp are characterized by small ratio of fats in its meat (~ 0.6%) as compared with its counterpart in Bass (~ 1.2%), in chicken (14%) and veel (12%) [1].

Shrimp has its high economic importance whereas its price in 2006 was classified into 4 classes according to species and weight [2, 3] as following: (1) shrimp of the first class contained 20 shrimp units/kg, the price of the ton reaches about 122.8×10^3 L.E, (2) shrimp of the second class contained 21 to 45 units/kg, the price is about 76.4×10^3 L.E per ton, (3) shrimp of the third class contained 46

to 60 units/kg, the price is about 46.7×10^3 L.E per ton and (4) shrimp of the fourth class contains more than 61 units/kg, its price is about 22.9×10^3 L.E. [2, 3].

Marine crustaceans are certainly considered as a luxury goods on which the demand increases, especially in the restaurants of the tourist villages and cities that are spreading in the Egyptian shores and beaches. Also, it becomes a good available commodity for elite consumers with high income which lead to the increasing in their prices in the last period. Even though the relative importance of marine crustaceans amounted only by about 1.6% from the total Egyptian fish product that have reached about 971 thousand ton in 2006 which contributed by about 7.8% from the total Egyptian gross fish income that evaluated by 9.3×10^9 L.E during the same year [2].

This research aimed to study the marine crustaceans (shrimp and crab) in the Egyptian fisheries during the period from 1990 to 2006 to investigate the following: (1)

the relative importance of the marine crustaceans in the Egyptian fisheries, (2) the annual growth rate in the production of marine crustaceans, (3) forecasting crustaceans products till 2012 and (4) the prices of marine crustaceans and its effect on the production

MATERIALS AND METHODS

The research was depended on the data published by the General Authority for Fish Resources and Development (GAFRD) during the period 1990-2006 and also on the relevant Arab and foreign references. The research was depended on the descriptive economic analysis as well as econometric methods to release the purpose of the research [4-6]. In this study, the following equations were used:

- C Exponential function. 2. Regression model. 3. Marginal increment. 4. The non equality coefficient (U-Theil) [5, 6].

This study depended on the average price of the four shrimp classes during the time of research, because the available data about the shrimp production are quantitatively not qualitatively [2]. On the other hand, the ratio of animal protein for crab lies between 12.8-16.6% and the amount of fats lies between 2-5%, meanwhile the price of crab in 2006 is 11.9×10^3 L.E per ton [2].

RESULTS

The Relative Importance of Marine Crustacean in the Egyptian Fisheries: It appears from Table1 that the product of shrimp occupies the largest share of crustaceans form both production and economic sides during the period of study (1990-2006). Crustaceans have contributed by a minimum range reaches about 5.40 thousand ton in 1992, whereas 80% represents the product of shrimp which was evaluated by about 23.6×10^6 L.E, while the rest represents the product of crab evaluated by about 3.7×10^6 L.E during the same period. From the other side, crustaceans contribute by a maximum rate reached about 15.1 thousand ton in 2006 whereas 65.5% referred to the product of shrimp with value reaches 665.6×10^6 L.E. On the other hand, the crab products represents about 34.5% accounted by 5.2 thousand ton with mean prices reaches about 62.2×10^6 L.E during the same period. Therefore, the shrimp contributes by an average range product evaluated yearly by about 7.9 thousand ton (i.e. 71.7% of total crustaceans production during the period of the study). The value of shrimp is

about 312.1×10^6 L.E compared by 24.1×10^6 L.E for crab during the same period.

The marine fisheries occupies the first class in the production of both crab and shrimp during the period of the study whereas, it has contributed 63.4 and 62.1% of the year production of shrimp and crab, respectively. On the other hand, the lake fisheries have contributed by an annual average evaluated by about 36.6% from the total product of shrimp and about 37.9% from the total product of crab at the same period (Table 1).

The main species of shrimp that grow in the Egyptian fisheries are *Penaeus Kerathurus*, *P. Japonicus*, *Meta Penaeus Monoceros*, *Meta Penaeus Stebbin*, *P. Semisulcatus*, *Trachy Penaeus Curvirostris*, *Parapenaeus longirostris* and *Penaeus Sulcatus*. While, there are many species of crab grow in the Egyptian fisheries such as *Portunus Pelajicus*(L), *Calinectes Sapidus* (Rath) and *Carcinus Meanus* (L).

The Annual Growth Rates in the Production of Marine Crustaceans: The rate of annual growth in the product of shrimp from the Egyptian fisheries during the period 1990-2006 was calculated using the following equation:

$$\text{Log. Y} = 8.682 + 0.031 X \\ (98.251)^{***} (3.543)^{**} \\ R^2 = 0.46 \quad F = (12.552)^{**}$$

Whereas;

Y= estimated product,

X= time by years,

* P # 0.05, ** P # 0.01, *** P# 0.001.

It has been shown that: 1) the growth rate in the marine shrimp reaches about 3.1% annually, 2) the factors related to time explain 46% of the annual changes in the product of shrimp according to the determinant factor R^2 and 3) it was proved the significance of the model at an probability level < 0.01 .

While for crabs the annual growth rate was calculated according to the following equation:

$$\text{Log y} = 6.682 + 0.128 X \\ (39.673)^{***} (7.767)^{***} \\ R^2 = 0.80 \quad F = (60.328)^{***}$$

It was found that: 1) annual rate of growth in their product reaches about 13%, 2) about 80% of the annual production changes is related to time factor according to the determinant factor R^2 and 3) the significance of the model was proved ($P < 0.001$).

Table 1: The evolution of the product and prices of crustaceans in Egyptian fisheries during the period of 1990-2006

Years	Shrimp (ton)			Crab (ton)			Total Crustaceans (ton)	Prices (thousand 10 ³ L.E per ton)	
	Seas	Lakes	Total	Seas	Lakes	Total		Shrimp	Crab
1990	3985	2533	6518	552	125	677	7195	5.0	2.9
1991	4304	2267	6571	707	152	859	7430	5.3	3.1
1992	3152	1143	4295	1013	111	1124	5419	5.5	3.3
1993	4113	2055	6168	1298	250	1548	7716	5.8	3.5
1994	4530	4687	9217	684	657	1341	10558	18.0	3.8
1995	4734	3169	7903	1175	990	2165	10068	40.1	3.0
1996	3808	2286	6094	981	557	1538	7632	40.1	4.0
1997	5490	2387	7877	1067	838	1905	9782	40.1	9.0
1998	5507	2886	8393	1398	918	2316	10709	41.7	12.9
1999	8269	1388	9657	4701	1237	5938	15595	39.6	10.6
2000	7063	2411	9474	3866	2473	6339	15813	59.9	11.1
2001	5291	2450	7741	1904	2192	4096	11837	60.3	9.1
2002	6023	2326	8349	2900	2029	4929	13278	55.4	9.9
2003	4234	2874	7108	3454	1469	4923	12031	59.6	10.1
2004	5292	5089	10381	2030	1455	3485	13866	61.4	11.0
2005	4907	4464	9371	2678	2141	4219	14190	62.5	10.3
2006	4876	5029	9905	2637	2591	5228	15133	67.2	11.9
Average	5034	2908	7942	1944	1187	3131	11093	39.3	7.7
%	63.4	36.6	100	62.1	37.9	100	-	-	-
%		71.7			28.3		100	-	-

The source [2]

Table 2: The future expectance about the production of marine crustaceans in the Egyptian fisheries till 2012

Years	Shrimp		Crab		Total Crustaceans	
	Real value thousand ton	Estimated value thousand ton	Real value thousand ton	Estimated value Thousand ton	Real value thousand ton	Estimated value thousand Ton
1990	6.5	6.1	0.7	0.9	7.2	6.9
1991	6.6	6.3	0.9	1.0	7.4	7.3
1992	4.3	6.5	1.1	1.2	5.4	7.7
1993	6.2	6.7	1.5	1.3	7.7	8.1
1994	9.2	6.9	1.3	1.5	10.6	8.6
1995	7.9	7.1	2.2	1.7	10.1	9.0
1996	6.1	7.3	1.5	2.0	7.6	9.5
1997	7.9	7.5	1.9	2.2	9.8	10.0
1998	8.4	7.8	2.3	2.5	10.7	10.6
1999	9.7	8.0	5.9	2.9	15.6	11.2
2000	9.5	8.3	6.3	3.3	15.8	11.8
2001	7.7	8.5	4.1	3.7	11.8	12.4
2002	8.3	8.8	4.9	4.2	13.3	13.1
2003	7.1	9.0	4.9	4.8	12.0	13.8
2004	10.4	9.3	3.5	5.4	13.9	14.6
2005	9.4	9.6	4.8	6.2	14.2	15.4
2006	9.9	9.9	5.2	6.9	15.1	16.2
2007	-	10.2	-	7.9	-	17.1
2008	-	10.5	-	9.0	-	18.0
2009	-	10.9	-	10.2	-	18.9
2010	-	11.2	-	11.6	-	20.0
2011	-	11.5	-	13.2	-	21.1
2012	-	11.9	-	15.0	-	22.3

The source: [2]

For studying the annual growth rate of the marine crustaceans in the Egyptian fisheries during the period of research (1990-2006) the following model was used:

$$\text{Log } y = 8.790 + 0.053 X$$

$$(98.294)^{***} (6.084)^{***}$$

$$R^2 = 0.71 \quad F = (37.010)^{***}$$

It has been shown that: 1) the rate of growth in the marine crustaceans estimated by 5% annually, 2) factors related to time explain about 71% of the annual production changes, according to the determinant factors R^2 and 3) the significance of the model was proved ($P < 0.001$).

The Future Production of Crustaceans in Egyptian Marine Fisheries: The annual growth rates have been used in forecasting the quantitative production of crustaceans from Egyptian fisheries till 2012. After testing the ability of the regression power estimated to forecast the past and the present during a period of time to make an evaluation through calculating the (U-Theil) coefficient.

From Table 2 and Figure 1 it has shown that the future forecasting about the production of marine shrimp from the Egyptian fisheries will reach about 11.9 thousand ton by 2012 and the ability of the regression model to estimate the forecast production level during certain time is suitable since the Co-efficient of (U-Theil) was estimated by about 0.4 only.

It appears also from the Table 2 and Fig. 2 that the future of marine crab from Egyptian fisheries will react to about 15.0 thousand ton by 2012 and the 'U-Theil' value was about 0.7 only.

It also appear from Table 2 and Figure 3 that the future production of marine crustaceans (shrimp and crab) will reach 22.3 thousands ton by 2012 and the "U-Theil" value was about 0.8 only. The forecasted increase in shrimp catch in 2012 being 16% of the actual catch for 2006, while the crab increases in 2012 was doubled that of 2006.

The Study of Marine Crustaceans Prices and Their Influence on Production: From Table 1, it is evident that the shrimp prices in local markets reach the lowest level by about 5×10^3 L.E per ton in 1990 and reached the top by 67.2×10^3 L.E per ton in 2006, with annual average price about 39.3×10^3 L.E per ton during the period of study (1990-2006). While for crab prices in local markets, it reach the lowest level by about 2.9×10^3 L.E per ton in 1990 and reached the top by about 11.9×10^3 L.E per ton in 2006 with annual average of about 7.7×10^3 L.E per ton during the period of study.

The annual rate of the increase of shrimp prices in the local markets was calculated according to the following equations:

$$Y = 0.624 + 4.293 X$$

$$(0.161) (11.352)^{***}$$

$$R^2 = 0.90 \quad F = (128.249)^{***}$$

Where:

y = estimated price of shrimp.

x = time of years.

Annual rate of the increase of shrimp price = $\frac{b}{\bar{y}} \times 100$

Where: b is coefficient of x in the above equation. \bar{y}

\bar{y} = Average of shrimp price during the period of study (Table 1).

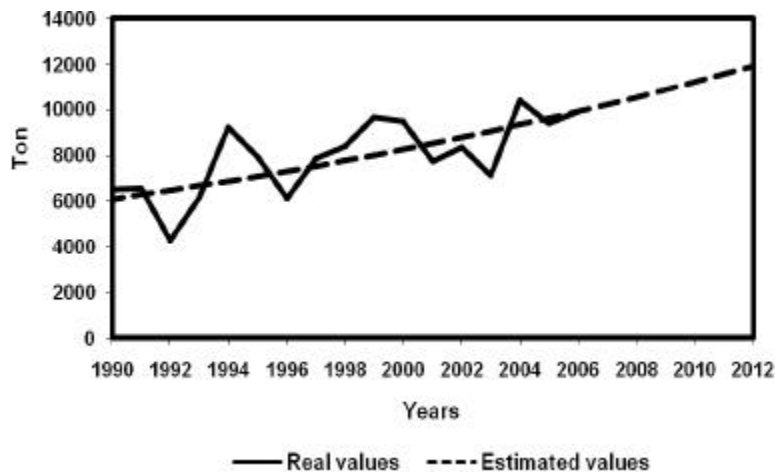


Fig. 1: The future forecast about the production of shrimp in Egyptian fisheries till 2012

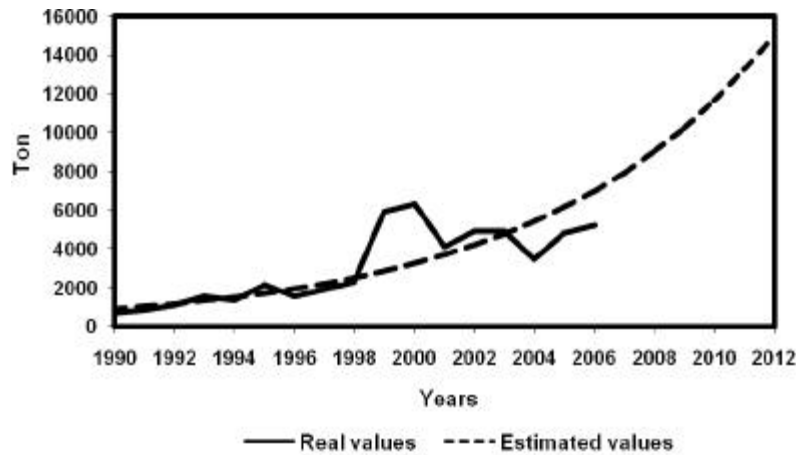


Fig. 2: The future forecast about the production of crab in Egypt fisheries till 2012

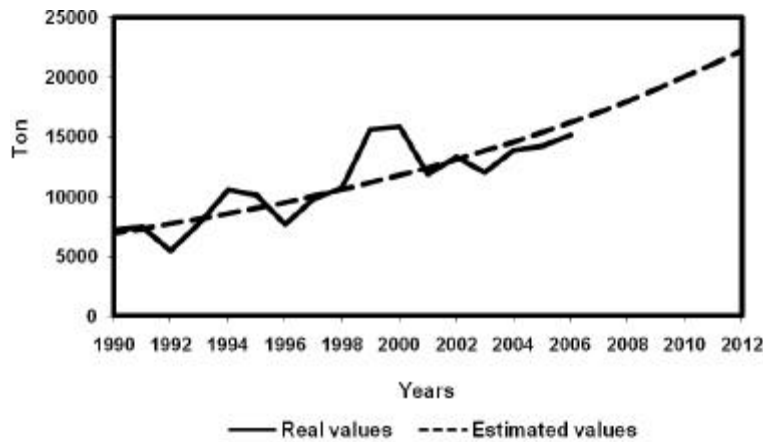


Fig. 3: The future forecast about crustaceans production in in Egypt fisheries till 2012

It has been shown that the annual increase in price according to the above equations was found to be 10.9%.

For crab prices in the local markets during the period of study the following linear equation was used:

$$Y = 1.880 + 0.638 X$$

(1.811) (6.293)^{***}
 $R^2 = 0.73$ $F = (39.598)^{***}$

It was evident that the increase of annual rate of crab prices is amounted by about 8.3% from the annual average for crab prices during the period of study.

According to the estimated linear equation for shrimp and crab prices, it was expected that the price of shrimp will reach about 99.4×10^3 L.E per ton by 2012, while that of crabs will be about 16.6×10^3 L.E per ton.

By estimating and measuring the influence in the change of prices of marine crustaceans on its annual production during the period of study (1990-2006), it has

been shown that the best model estimated for shrimp is the double log model in the following form:

$$\text{Log } y = 8.415 + 0.373 \text{ log } X$$

(57.869)^{***} (3.880)^{**}
 $R^2 = 0.50$ $F = (15.053)^{**}$

From this model it is clear that the change in shrimp prices by 1% leads to similar change in production by 0.4%.

The best model estimated for crabs is a double log model in the following form:

$$\text{Log } y = 5.876 + 2.391 \text{ log } X$$

(18.196)^{***} (6.330)^{***}
 $R^2 = 0.73$ $F = (40.064)^{***}$

From this model it is clear that the change in crab prices by 1% leads to similar change in production by 2.4%.

DISCUSSION

From the foregoing results, it has been found that the annual rate growth in crab is 13% and thus shrimp has 3% annual rate growth. This is due to the chemical and biological properties of the water environment in the Egyptian fisheries which is directly proportional with the growth and the production of crabs, while the decline in the annual rate product of shrimp is due to many factors, the most important of them is illegal method of fishing and catching the immature small shrimp (fry's) for facing the increased demand on it, while in turn leads to the decrease of stock potential of shrimp in the Egyptian fisheries [7,8]. This increase is rather small due to biological determinants and also the administrative aspects whereas the time of stop catching is not adequate to the tourist demand in the country. In this regard, cultivative marine crustaceans and the other marine fishes is seen necessary since the required technique is available at present, whereas the Egyptian National Institute of Oceanography and Fisheries (NIOF) and (GAFRD) were succeeded in spawning and cultivating shrimp.

GAFRD have also investigated a marine region in Red sea, such as Lagoons, depressions and gulfs. All these regions are adequate to establish the projects of marine cultivation [9].

The researches of NIOF and the other international organizations in Egypt have made clear that the risks of investments of marine crustaceans fisheries are few.

From the previous results, it is clear that the current prices and the future prices of shrimp are more than their counterparts of crab by about 5.6 times. In general the marine crustaceans prices are in continuous increase and this is for the following reasons:

- C The demand of fish, which show change of long term, this can be shown in the changes of demand for foodstuffs as in the case of American and European countries and changes of short term this can be shown in per-capita income. Its clear from the earlier study [10] that the elasticity of income demand of fish is about 1.15 which mean that there is changes in the real per-capita consumption of fish equal to 1% and it leads to change the per capita consumption of fish equal to 1.2%
- C Social factors including number of population, the prevailing customs and traditions in the community and the tastes and patterns of consumer. Whereas,

there is a food gap of fish in Egypt which is widening from year to year that is because of the high rate of annual population increase and the preference of fresh fish form frozen [11].

- C Management factors including the government intervention in determining production and this is by stopping fishing in certain seasons, in certain fisheries and determining the number of licenses given to practice the productive activity according to the laws of fishing and determining the quantities marketed and the domestic and export prices [11].
- C The increasing of the index number for living expenses results of the high prices of foods, in general and the high prices of animal products in particular that is lead to increase the demand of fish as a alternative commodity for red meat [12].
- C The wide spread of luxury marketing for marine crustaceans in restaurants, hotels and tourist villages which leads to increase its prices [13].

Investment incentives in crustaceans cultures are due mainly to economic investment, Environmental incentives and the food incentives [14].

It could be concluded that the marine crustaceans constitute about 1.6% of the total fish catch in Egypt it contributes about 7.8% of the gained gross fish income. Forecasted shrimp catches by the year 2012 was estimated of limited increase, it is suggested to utilize gulfs, lagoons and depressions in the Egyptian Med. / Red shores in shrimp culture. The risk of the investments in the marine crustaceans fisheries or aquaculture is a little due to the high investment incentives which referred by the high value of the product, as well as environmental and food incentives.

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