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Estimation of the Standard Economic Factors Affecting Food Security Coefficient of Fish in Egypt

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ABSTRACT

The present paper was presented to address the economic dimension of the food security policy of fish in Egypt. Hence, a list of the following sub-objectives was targeted; study the current status of fish production and consumption in Egypt during the study period (2000-2018), estimate the strategic stocks and food security factor of fish in Egypt during the study period (2000-2018), and finally, examine the economic factors affecting the food security factor of fish in Egypt during the study period. The current findings showed that the increase of one million pounds in the agricultural sector investment led to an increase of 0.0014 units in the food security factor of fish. This indicates that a 10% increase in investment in the agricultural sector would lead to the possibility of a 23% increase in the food security factor of Fish. The statistical significance level of 1%, recorded in the present work, assessed the considerable impact on the agricultural investment in the security factor of fish. Hence, verification for the rise in the value of real per capita income would be attainable; recording a shift from 5,300 pounds in 2000 to 26,117 pounds in 2018; with an increase of about 20,817 pounds, or about 392.8% of the value of per capita income in the year 2000, and with a general average of about 14,491.51 pounds during the period (2000-2018). The significance of the effect of real per capita income on the food security coefficient of fish was proved at the level of statistical significance of 1% which, in turn, fortifies the coefficient regression and the economic logic.

INTRODUCTION

Food security is a crucial necessity for all beings worldwide, and for Egyptians, in particular. A great attention should be drawn to Egyptian local sustainable resources among which is fish; one of the main pillars in providing animal protein in general and fish protein in particular at prices compatible with the individuals' financial affordabilities. The concept of food security depends mainly on two axes: the quantity and food type required to realize food security, and the way to get food, whether from local or foreign sources, and guarantee a ceaseless flow of food source **(Gerges, 2008)** .

Doubtlessly, food insecurity is one of the most major threats to stability and security at the local, national, regional and international levels. Food is the first life element for all the livings, and any lack to meet their needs and food preferences in a way that they can lead an active and healthy life leads to turmoil, chaos and insecurity. Providing food, with its various components, at suitable and affordable prices is a real challenge to food policies of any country. In addition, it is one of the most important reason for establishing security in society which mirrorizes the relationship between governments and citizens (**Ghanem and Qamar, 2010**).

Animal production sector has won a great interest because it is the only animal providing protein source for human food, represented in red meat, poultry meat, fish, dairy and eggs . Fish is one of the basic commodities for most members of society, which occupies an advanced position in the Egyptian food consumption patterns due to the relatively low prices compared to other protein sources (**Attia, 2006)**.

Egypt enjoys a diversity of sources of fish resources, whether from natural fisheries or fish farming, giving fish production sector a comparative advantage. For what it provides from animal protein to consumers is about 25% compared to other sectors. Therefore, this sector is granted radical in affecting the Egyptian food security **(Al-Karyouni and Abdel-Hafez, 2008)** , where fisheries contribute by about 37. One million tons represents about 19.29%, and fish farming about 1.63 million tons represents about 80.71% of the total fish production in Egypt. This amounted to about 1.93 million tons in 2018, while the volume of local consumption reached about 1.04 million tons in the same year. Thus, it seems important to promote the development of fisheries resources to increase fish production and increase self-sufficiency rates to meet the consumption needs of fish in respect to the high prices of other protein sources **(GAFRD, 2018).**

Research problem:

The problem of providing food has become a real challenge for the Egyptian society due to the imbalance between the consumer needs of sound nutrition and preventive foundations and what is actually available. A governmental growing concern have been launched to increase fish production from multiple sources. Consequently, the average value of fish production reached about 1.21 million tons, while the actual consumption was about 0.897 million tons, and the self-sufficiency rate reached about 83% recording an average for the period (2000-2018) Yet, it is noticeable that this outstanding sector is exposed to many obstacles that led to instability and low fish production. This, in turn, leads to the difficulty of future projections for possible changes in fish production, especially in the light of the succession of many crises that threatened Egyptian food security, including epidemics and fish diseases. The high global prices of fish feed for fish farming, and the rise in import prices resulting from economic and political changes necessitate a profound study on the aspects of fish production and consumption to maintain a strategic stock of fish. Whether local or imported fish production, a strategic stock of fish should be maintained to meet consumer needs to face emergency conditions, achieve stability and food security in Egypt through the realizing the optimum utilization of available fish production resources.

Research Objectives:

This study aimed to identify the economic dimension of the food security policy for fish in Egypt by achieving the following sub-objectives:

1- Study the current status of fish production and consumption in Egypt during the study period (2000-2018).

2 - Estimating the strategic stocks and food security factor of fish in Egypt during the study period (2000-2018).

3- Study the economic factors affecting the food security factor of fish in Egypt during the study period.

MATERIALS AND METHODS

In achieving its objectives, this study relied on quantitative and descriptive economic analysis as follows:

First: Calculating the food security factor for fish:

By using the following economic equations:

1- Period of adequacy of production for consumption = Gross Domestic Production ÷ Daily Domestic Consumption.

2 - Period of coverage of imports for consumption = total imports ÷ daily domestic consumption.

3 - The amount of surplus and deficit in fish = [(the sum of the length of the two adequacy periods of production and import coverage - 365) x daily domestic consumption] - (the quantity of exports).

4 - Food Security Factor = the size of the strategic stock (sum of surplus and deficit) ÷ Average of annual domestic consumption **(FAO, 2014).**

Second: the estimation of the Tobit Regression model

In this part, several tests were performed before estimating the regression model, namely; unit root test, co integration test, and causality test, followed by the estimation of the regression model (Tobit Model) **(Fry, 1991)**.

This method is called Tobit Censored - Truncated Regression, relative to James Tobin, which is used to estimate the parameters of the regression function with a limited dependent variable, (where the value of the security parameter ranges food security factor value between zero and the correct one with zero or negative observations substituted with zero). This method is used instead of using the traditional method of analysis (OLS method) which, assumes that there are no limits for the dependent variable (+ ∞, -∞). In addition, it proved that OLS estimates were below the actual values, and biased downward when setting limits for the dependent variable (Yi) as follows:

$$Y_i = \beta x_i + u_i$$

Where random variables are normally distributed $u_i \approx (\sigma, \mu)$

By setting a maximum for the dependent variable (Yi), so that Yi = <C and thus the previous regression equation could be reformulated as:

$$\beta x_i + u_i \leq C$$

Thus, we found that:

$$u_i \leq C - \beta x_i$$

Therefore, the expectation of random error was not equal to zero, as the OLS method assumes. This prediction could be formulated as follows:

$$E(u_i | u_i \leq C - \beta x_i) \neq 0$$

That is, the expectation of the random error E (Ui) is a function of the independent variable (Xi) and so the remainder (Y - Y ^) will be related to the independent variable, and therefore estimates of the model regression coefficients will be unacceptable if the OLS method is used. Where the value of the random variable is expected to diminish by increasing the value of the independent variable as long as B> O, ,and therefore, the OLS estimates of the regression coefficients will be down-biased i.e. the estimates of the regression coefficients will be less than their actual value.

Therefore, the use of the unconventional analysis method known as the Tobit model, which allows setting limits for the dependent variable was accepted. It becomes necessary to address the bias in the OLS estimates. There are two methods of estimating the first model, the Truncated Tobit regression method, in which the zero and negative observations are deleted from the dependent variable and their corresponding counterpart with the independent variables. Then, the model is estimated on the rest of the observations, and the second method is the Tobit Censored, where the model is fully estimated by entering all the observations and replacing the zero and negative observations in the dependent variable is only zero. To estimate the regression coefficients in this case, it is necessary to apply the Maximum Likelihood Estimator (MLE) method, **(Olsen, 1978:Akerolf, 1980)** where the regression equation in the model can be formulated as follows:

$$\overset{*}{Y} = \beta' x_i + u_i$$

Where:

$$y_i = L_{1i} \quad \text{if} \quad y_i < L_{1i}$$

$$y_i = \overset{*}{Y} \quad \text{if} \quad L_{1i} \le \overset{*}{Y} \le L_{2i}$$

$$y_i = L_{2i} \quad \text{if} \quad y_i > L_{2i}$$

Where L_{1i} expresses the minimum of the dependent variable (i) while L_{2i} expressing the maximum of the same change. While $\overset{*}{Y}$ expresses the dependent variable between the minimum and maximum limits or the finite dependent variable **(Ghanem, 1997).**

To estimate the parameters of the regression function in this case using the MLE method, it is necessary to formulate **(Madala, 1987)** Likelihood Function, **(Green, 1993)** as follows:

$$L(\beta, \sigma | y_i, x_i, L_{1i}, L_{2i})$$

$$= \prod_{y_i = L_{1i}} \Phi\left(\frac{L_{1i} - \beta' x_i}{\sigma}\right).$$

$$\prod_{y_i = \overset{*}{Y}} \frac{1}{\sigma} \phi\left(\frac{y_i - \beta' x_i}{\sigma}\right). \prod_{y_i = L_{2i}} \left[1 - \Phi\left(\frac{L_{2i} - \beta' x_i}{\sigma}\right)\right]$$

Thus, the expected value of the dependent variable E (Yi) becomes as follows:

$$E(y_i \mid L_{1i} < \overset{*}{Y} < L_{2i})$$
$$= \beta' x_i + E(u_i \mid L_{1i} - \beta' x_i < u_i < L_{2i} - \beta' x_i) + P(y_i - L_{2i})L_{2i}$$
$$= \beta' x_i + \sigma \frac{\phi_{1i} - \phi_{2i}}{\Phi_{2i} - \Phi_{1i}}$$

Where:

$$\Phi_{1i} = \Phi(\frac{L_{1i} - \beta' x_i}{\sigma}), \Phi_{2i} = \Phi(\frac{L_{2i} - \beta' x_i}{\sigma})$$
$$\phi_{1i} = \phi(\frac{L_{1i} - \beta' x_i}{\sigma}), \phi_{2i} = \phi(\frac{L_{2i} - \beta' x_i}{\sigma})$$

Each of the probability density function Φ, ϕ is known as a function of the probability distribution. Thus, it was possible to estimate the parameters of the regression function of the food security coefficient with a finite dependent variable **(Ghanem, 1997).**

The coefficient of determination is also estimated in the model as follows:

$$R^2 = 1 - \sum_{t=1}^{T} \varepsilon_t^2 / \sum_{t=1}^{T} (Y_t - Y^-)^2$$

$$\varepsilon_t = Y_t - (\sigma f(X_t \ \beta) + \sigma F(X_t \ \beta)(X_t \ \beta))$$

The elasticity's of the model are estimated as follows:

$\eta i = \beta i \dot{X}_i / \dot{Y}$

Data Sources:

This study relied on secondary data published in the Central Agency for Public Mobilization and Statistics, the General Authority for Fish Resources Development, the Economic Affairs Sector of the Ministry of Agriculture and Land Reclamation, The website of the International Monetary Fund, the World Bank, and the Food and Agriculture Organization (FAO).

RESULTS AND DISCUSSION

First: the current status of fish production and consumption in Egypt:

By studying the current situation of fish production and consumption in Egypt, in order to identify the self-sufficiency rate and average per capita share during the study period (2000-2018), as indicated by Table (1):

- The local production of fish increased from about 724 thousand tons in 2000 to 1935 thousand tons in 2018, with an increase of about 1211 thousand tons, which represents about 167.26% of the amount of production in 2000, and an average of about 1211.84 thousand tons as an average for the study period (2000-2018).

- The population increased from about 63.97 million in 2000 to 97.14 million in 2018, with an increase of about 33.17 million people, or about 51.85% of the population in 2000, and at an average of about 78.15 million people as an average for the study period (2000-2018).

- The increase in the population resulted in an increase in fish consumption from about 856 thousand tons in 2000 to 1047 thousand tons in 2018, an increase of about 191 thousand tons, or about 22.31% of the amount of consumption in the year 2000, and an average of about 897.47 thousand tons as an average for the period of study (2000-2018).

- This also resulted in an increase in fish imports from about 213.63 thousand tons in 2000 to 324 thousand tons in 2018, an increase of about 110.37 thousand tons, or about 51.7% of the amount of imports in 2000, and an average of about 254.35 thousand tons as an average for the period of study. (2000-2018), and this led to an increase in the average per capita share from about 14.64 kg / year in 2000 to 22.98 kg / year in 2018, an increase of about 8.34 kg / year, or 56.96% of the average per capita share in 2000 , With an average of about 17.7 kg / year as an average for the study period (2000-2018).

- As shown in Table (1), the percentage of self-sufficiency in fish increased from about 77.29% in 2000 to 86.66% in 2018. An increase of about 9.37%, or about 12.12% of the self-sufficiency rate in 2000 was detected, and an average of about 83% was recorded as during the study period (2000-2018).

Table(1) Development of local production, imports, exports, local consumption, population, self-sufficiency rate and average per capita fish portion during the period(2000-2018)

Years	Quantity of local production (thousand tons)	Quantity of imports (thousand tons)	Actual consumption amount (Thousand tons)	Quantity of exports (thousand tons)	Population (million people)	Self-sufficiency ratio	Fish per capita (kg / year)
2000	724	213.63	856	0.96	63975.9	77.29	14.64
2001	772	261	943	1.22	65336	74.78	15.79
2002	801	154	943	2.56	66668	84.07	14.30
2003	876	163	908	3.13	67976	84.57	15.24
2004	865	221	863	1.91	69330	79.80	15.63
2005	889	189	906	5.12	69997	82.90	15.32
2006	971	208	730	4.05	70653	82.67	16.62
2007	1008	259	943	4.42	74357	79.84	16.98
2008	1068	137	719	6.73	75097	89.14	15.95
2009	1093	136	743	7.59	76823	90.64	15.89
2010	1305	257	917	10.60	78728	84.13	19.70
2011	1362	182	903	9.49	80410	88.75	19.09
2012	1372	335	850	15.81	82305	81.12	20.55
2013	1454	236	839	20.45	84628	87.10	19.73
2014	1482	584	1029	28	86811	72.72	23.47
2015	1519	296	904	19	88958	84.61	20.18
2016	1706	311	993	47.81	91023	86.63	21.64
2017	1823	366	1016	35,11	94,799	84,61	22,72
2018	1935	324	1047	26,3	97,147	86,66	22,98
Average	1211.84	254.35	897.47	11.11	78159.05	82.99	17.69

1 - The Central Agency for Public Mobilization and Statistics - Fisheries statistics - miscellaneous issues.
2- The Central Agency for Public Mobilization and Statistics, the annual bulletin of the movement of production and foreign trade and the available for consumption of agricultural commodities, various issues.
3- The International Monetary Fund website. www.imf.org/external/data.htm
4- The website of the Food and Agriculture Organization. www.fao.org

Second: Estimating the strategic stocks and food security factor of fish in Egypt:

The size of the strategic fish stocks in Egypt was estimated by evaluating the size of the surplus and deficit of fish for local consumption during the period (2000-2018). The value of the food security factor ranges between (1-0), as the more the value of the food security factor approaches zero, the more food insecure becomes. And vice versa, while the closer the value of the food security factor is in the correct one, the increase the food security of the commodity in the country.

- A review of the data contained in Table (2) revealed the following:

1 - The time interval of product efficiency for domestic consumption increased from about 308.71 days to approximately 674.71 days in 2018. While the period for covering imports for domestic consumption increased from about 91.09 days in 2000 to about 112.95 days in 2018. Considerably, the increase in the adequacy period of production and the decline in the period of import coverage for domestic consumption is a good indicator for the interest of the Egyptian economy protecting it from imported inflation risk, and thus, reduce both foreign dependancy and the deficit in payment balance. Hence, this would protect food security from the economic, political and climatic fluctuations of monopoly countries with respect to the production and export of fish in the world.

2 - A surplus of fish, locally produced or imported, in local consumption was realized during the period of the study (2000-2018), as the average total of this surplus was estimated at 288.21 thousand tons, sufficient to cover an average consumption of approximately 117.15 days / year. This surplus is directed to develop the strategic fish stocks, to be withdrawn during the other years during which there is a deficit of fish destined for local consumption.

3- In the light of both the strategic stocks and the average domestic consumption of fish which amounted to about 228.21 and 897.47 thousand tons, respectively, the food security factor of fish in Egypt was estimated at 0.25 during the study period. This indicates the relative increase in the amount of the food security factor of fish, which is justified for the amount of imports and local production of fish. Therefore, it is necessary to cooperate with the concerned government agencies to increase the food security factor of fish by increasing the local production of fish and expanding fish farming to create an accumulation in the strategic stocks sufficient for local consumption, thus achieve food security of fish in Egypt.

Table No. (2) Evolution of indicators for the two production adequacy periods, coverage of imports and the amount of surplus or deficit of fish destined for domestic consumption in Egypt during the period (2000-2018)

Years	Daily consumption (thousand tons)	**Sufficiency period of production for consumption per day**	**The period of coverage of imports for consumption per day**	**The sum of the two shifts per day**	**Surplus and deficit**		**Value of the food security factor ****
					The quantity is in thousand tons	**Adequacy of the surplus or deficit in domestic consumption per day**	
2000	2.35	308.71	91.09	399.81	81.63	34.81	0.041
2001	2.58	298.81	101.02	399.84	90	34.84	0.037
2002	2.58	310.04	59.61	369.64	12	4.64	0.005
2003	2.49	352.14	65.52	417.66	131	52.66	0.058
2004	2.36	365.85	93.47	459.32	223	94.32	0.109
2005	2.48	358.15	76.14	434.29	172	69.29	0.076
2006	2.00	485.50	104.00	589.50	449	224.50	0.308
2007	2.58	390.16	100.25	490.41	324	125.41	0.133
2008	1.97	542.17	69.55	611.72	486	246.72	0.343
2009	2.04	536.94	66.81	603.75	486	238.75	0.321
2010	2.51	519.44	102.30	621.73	645	256.73	0.280
2011	2.47	550.53	73.57	624.10	641	259.10	0.287
2012	2.33	589.15	143.85	733.01	857	368.01	0.433
2013	2.30	632.55	102.67	735.22	851	370.22	0.441
2014	2.82	525.69	207.15	732.84	1037	367.84	0.357
2015	2.48	613.31	119.51	732.83	911	367.83	0.407
2016	2.72	627.08	114.32	741.39	1024	376.39	0.379
2017	2.78	654.92	131.49	786.40	1173	421.40	0.415
2018	2.87	674.57	112.95	787.52	1212	422.52	0.404
Average	**2.46**	Average strategic reserve = 228.21			**the food security factor** = 0.25		

** The value of the safety factor = (the amount of surplus or deficit / the amount of domestic consumption)

Source: Calculated from the data of Table (1)

Third: Economic factors affecting the food security factor of fish in Egypt:

With regard to analyzing the impact of the most important factors that are supposed to have an impact on the food security factor of fish as a dependent variable, and the most important economic factors that can be considered indirectly influencing them as independent variables which are fish investment in billions of pounds (x1), population in million people (x2), The value of real per capita income in pounds (x3). This was undertaken after excluding the variables that have a direct impact on the food security factor of fish, which are the quantity of production, the quantity of imports, the quantity of exports, and the amount of consumption of fish, because they are variables directly included in the calculations of the food security factor.

In this part, several tests were performed before estimating the regression model, namely; unit root test, co integration test, and causality test, and then the estimation of the regression model was attained as follows:

1 - Unit root test results:

Data of Table (3) related to unit root tests (Augmented Dickey Fuller test (ADF), indicate statistical insignificance (t) at the 5% level of significance of the fish investment variable (x1) at the level. This indicates that those variables were not stable at levels, and the statistical significance at the level of 5% was also confirmed for the results of ADF. - Choi Z-stat and Im, Pesaran and Shin W-stat,which performed no-stable variable at levels, i.e. accepting the Hypothesis of unit root presence.

Taking the initial differences for the variables used in the estimation, the results of the tests (Extended Dicke Fuller test, t-test) revealed a significant (t) statistic at 5% significance level and some at 1%. In addition to the ADF - Fisher Chi-square statistic, and ADF - Choi Z-stat ADF - Choi Z-stat and Im, Pesaran and Shin W-stat, that all the variables have become stationary. The rejection of the null hypothesis in the presence of a unit root is necessary to avoid getting spurious results resulting from the use of unstable transactions. It is concluded that time series are not stationary at level chains but stationary in difference and each variable, separately, is considered integral of the first degree as long as the first difference for each of them is integral from the zero degree. These results are consistent with the standard theory that assumes that most macroeconomic variables are non stationary in Level but becomes stationary in the first difference.

2 - Results of the test using the Johansson Cointegration Test:

Table (4) shows the results of the cointegration test between the food security factor for fish, and the explanatory variables (the value of agricultural investment, the population, and the value of real per capita income). Considering the impact test that the calculated value of the effect test reached (154.14) at a level, with significance of 5%, the null hypothesis was rejected, indicating that there is no cointegration vector in the model. It is evident from the impact test that there were three vectors of co-integration between the model variables at each level with significance 5%, 10%. It is evident from the test of the greatest eigenvalue, that the calculated value of the greatest potential ratio reached (82.21) at the level with significance of 5%. Therefore, the null hypothesis was rejected. As resulted from Table (4) it became clear that there were three vectors for the cointegration at the level with significance of 5%, as the calculated value of the greatest possibility ratio reached (2.17), which is smaller than the critical value of (4.12). Thus, accepting the null hypothesis that there is no cointegration vector in the model was adjusted.

Table (3): Unit root test for time-series stationary using Augmented Dickey-Fuller (ADF)

Variables	ADF		
	at Level	1st Differences	Decision
Food security factor (y)	1.703 (2)*	-6.461 (0)***	l (1)
Fish investment (x1)	-0.120 (1)	-1.962 (0)**	l (1)
Population (x2)	9.711 (0)***	-0.280 (2)*	l (1)
Real per capita income (x3)	0.296 (0)***	-2.396 (2)*	l (1)
Method	ADF - Fisher Chi-square		
	(25.3)**	(46.4)***	l (1)
	ADF - Choi Z-stat		
	(1.03)	(-2.5)***	l (1)

***** Significance at the 1% level, according to MacKinnon (1996) table values.**

**** Significance at the level of 5% according to the table values of MacKinnon (1996).**

*** Significance at the level of 5% according to the table values of MacKinnon (1996).**

( ) The length of the automatic lagged period according to Schwartz Info Criterion, up to a maximum of 4 periods.

Source: Calculated from the data in the Appendix (1) and using the E-views 6 econometrics package

3 - Causality test results:

After achieving the statistical test and the Cointegration test, and before starting to estimate the (Tobit) regression model, it should be ensured that there is a causality relationship between the independent variables and the dependent variable. The Granger Causality Test was used to test the causality and the results were as showed in Table (5).The outcomings indicated that the result of the causality test was significant at the level of 5% and another at the level of 1%. Thus, the null hypothesis was rejected. It is concluded that changes in those independent variables caused substantial changes in the food security factor of fish Y, while the significant causal relationship between the independent variable X3 and the dependent variable (fish food security factor Y) did not appear unless this test was performed in 4 lagged for those variables.

Table (4) Results of Johansson Cointegration Test

Johansson Cointegration Test (Trace)				
(Hypothesized) No. of Cointegrations	Eigen value	Trace Statistic	Critical Value 5%	Prob.**
(None*)	0.9958	154.141	60.061	0.000
(At most 1*)	0.9443	71.929	40.174	0.000
(At most 2*)	0.6854	28.611	24.275	0.013
(At most 3*)	0.4542	11.262	12.320	0.074
Trace test indicates 6 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Johansson Cointegration Test (Maximum Eigen value)				
(Hypothesized) No. of Cointegrations	Eigen value	Trace Statistic	Critical Value 5%	Prob.**
(None*)	0.9958	82.2126	30.4396	0.0000
(At most 1*)	09443	43.3176	24.1592	0.0000
(At most 2*)	0.6854	17.3490	17.7973	0.0583
(At most 3*)	0.4542	9.0848	11.2248	0.1162
Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis kigkhnn™ hy m (1999) p-values				

Source: Calculated from the data in the Appendix (1) and using the E-views 6 econometrics package.

Table (5) Causality test between independent and dependent variables

Null Hypothesis	relationship direction	F-Statistic
X1 does not Granger Cause Y	(X1 → Y)	*** 9.7474
Y does not Granger Cause X1	(Y → X1)	0.0081
X2 does not Granger Cause Y	(X2 → Y)	*** 12.5742
Y does not Granger Cause X2	(Y → X2)	0.0036
X3 does not Granger Cause Y	(X3 → Y)	2.9449
Y does not Granger Cause X3	(Y → X3)	0.1099

*** Significant at 1% level ** Significant 5% level

Source: Calculated from the data in the Appendix (1) by using the E-views 6 econometrics package.

4 - Results of the Tobit Model estimation:

The regression function was estimated according to the unconventional analysis method known as the Tobit Model . By conducting the multiple regression analysis in the linear form using the Tobit Model method, it became clear from Table (6) that:

1 - Fish Investment (x1):

Fish investment is one of the branches of agricultural investment and one of the axes of sustainable agricultural development. Thus, achieving food security, as narrowing the gap between production and consumption and raising the efficiency of utilizing available resources, as well as leading to the establishment of new projects that develop productive and human capacity, which leads to increased rates of income growth and economic prosperity.

Reslts in appendix (1) shows an increase in the value of fish investment; recording 0.435 billion pounds in 2000 to 2.83 billion pounds in 2018. An increase of about 2.39 billion pounds; about 550.57% of the value of fish investment in the year 2000, and an average of about 1.39 billion pounds during the period (2000-2018) were detected.

The results of the model estimated in Table (6) indicated that a decrease in investment in the agricultural sector by one billion pounds led to an increase in the food security factor for fish by 0.0014 units. This shows that an increase in investment in the agricultural sector by 10% leads to the possibility of increasing the value of the food security factor of fish by 23%. The significant impact on agricultural investment in the security factor for fish was proved at a statistical significance level of 1%,and, in addition, the indication of the regression coefficient and economic logic was also agreed upon.

Table (6) The results of the Tobit regression model estimation of the food security factor of fish in the most important economic variables during the period (2000-2018).

Variables	Regression Coefficient	Elasticity's	(Z) Value	standard deviation
Constant	**-0.538**	**--**	**-2.134****	**0.2523**
Fish investment D (x1)	**0.0014**	**2.3**	**2.632*****	**0.0005**
Per capita income D (x2)	**-0.1239**	**-2.4**	**-2.584*****	**0.0479**
Population D (x3)	**-0.0108**	**-1.3**	**-2.797*****	**0.0038**

* significant at the level of 10% ** significant at the level of 5% *** significant at the level of 1%

Source: Calculated from the data in the Appendix (1) by using the E-views 6 econometrics package.

2- Value of real per capita income (x2):

Food security is a state of food stability in which food production efforts combine together with the purchasing power of individuals who do not produce food, so that all members of society are in a state that allows them to obtain their food in respect to their purchasing power. Therefore, studying the relationship between real per capita income and the food security factor of fish isof great importance.

It is clear from appendix (1), that the value of real per capita income rose from 5,300 pounds in 2000 to 26,117 pounds in 2018, with an increase of about 20,817 pounds, or about 392.8% of the value of per capita income in the year 2000, and with a general average of about 14,491.51 pounds during the period (2000-2018).

The results of the model estimated in Table (6) shows that an increase in real per capita income by one thousand pounds led to an increase in the food security factor of fish by 0.1239 units. This showed that an increase in real per capita income by 10% would lead to a decrease in the value of the food security factor of fish by 24%. The significance of the effect of real per capita income on the food security coefficient of fish was proved at the level of statistical significance of 1%. Addingly, this was the indication of the regression coefficient and the economic logic.

3- Population (x3):

There is no doubt that the increase in the population is associated with an increase in the demand for food, including fish, and the consequent imbalance between supply and demand of fish, forming a negative impact on food security. appendix (1) shows that the increase in the population of Egypt from 63.97 million people in 2000 AD to 97.14 million people in 2018 AD, with an increase of about 33.17 million people, or 51.85% of the population in 2000 AD, showing an average year of about 78.15 million people during the period (2000-2018).

The results of the model estimated in Table (6) performs that an increase in the population by one million people led to a decrease in the food security factor of fish by about 0.010 units, and this indicates that an increase in the population by 10% would lead to a 13% decrease in the value of the food security factor of fish. The significant effect of the population on the food security factor of fish was proved at a statistical significance level of 1%, and the reference for the regression coefficient and the economic logic was in agreement.

CONCLUSION

Fish represents an advanced place in the patterns of Egyptian food consumption due to the relatively low prices compared to other protein sources. Despite the increasing interest of the state to increase fish production from its various sources recently, as the average fish production reached about 1211.84 thousand tons and the volume of consumption reached about 897.47 thousand tons, yet it is noticeable that this important sector has been exposed to many obstacles that led to instability and decrease in fish production. The rate of self-sufficiency reached about 83% as an average for the period (2000-2018). It is difficult to project future changes in fish production and thus affect stability and food security of fish production in Egypt.

The research was conducted to identify the economic dimension of the food security policy of fish in Egypt during the period (2000-2018). To accomplish the current study goals, the research addressed the current situation of fish production and consumption in Egypt, the strategic stocks and food security factor for fish, and the economic factors affecting the food security factor for fish during this period.

- By studying the production and consumption situation of fish in Egypt during the period (2000-2018), it was revealed that the average of both production and fish consumption amounted to about 1211.84 and 897.47 thousand tons, respectively, while the self-sufficiency ratio reached about 83% 0

- By studying the current situation of food security, it was found that the quantity of strategic fish stocks amounted to about 228.21 thousand tons, sufficient for local consumption for 117.15 days, and the value of the food security factor during the study period was about 0.25.

The study recommends, in light of the research results that have been reached, through the following:

1 - Encouraging investment in the fish production sector by providing an appropriate investment environment.

2- Reducing pollution and depletion of fish stocks and collecting seed from capture fisheries.

3 - Expanding fish production in light of an appropriate strategy to increase local production, whether from capture fisheries or fish farming.

4 - Developing the current production systems and transferring modern technology related to this productive activity from other countries.

5- Establishing an information system on places of production, processing and marketing of fish activity.

6- Expanding the establishment of hatcheries to supply fish farms with different types of fish

Appendix (1)

Table (1) fish investment, per capita income, population, and actual fish consumption during the period (2000-2018).

Year	Population (thousands People)	Fish investment (thousand pounds)	Actual fish consumption (thousand tons)	Per capita income (pounds)
2000	63975.9	435324	856	5300
2001	65336	505571	943	5500
2002	66668	555747	943	5700
2003	67976	616846	908	6100
2004	69330	686325	863	7000
2005	69997	716553	906	7600
2006	70653	796163	730	6000
2007	74357	923208	943	10100
2008	75097	970562	719	11900
2009	76823	1041374	743	13200
2010	78728	1290306	917	15100
2011	80410	1498579	903	17100
2012	82305	1982957	850	18600
2013	84628	2229828	839	20502
2014	86811	2243596	1029	23313
2015	88958	2229828	904	25585
2016	91023	2518003	993	24891
2017	94799	2518000	1016	25731
2018	97147	2830000	1047	26117
Average	78159.05	1399408.95	897.47	14491.53

Source:

1- The Central Agency for Public Mobilization and Statistics, the annual bulletin of the movement of production and foreign trade that is available for consumption of agricultural commodities, various issues.

2 - The World Bank website www.data.albankaldawli.org/country/egypt

3- The website of the Food and Agriculture Organization, www.fao.org

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