AN ECONOMIC EVALUATION OF LAKE EDKU

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ABSTRACT

Fishery exploitation in Lake Edku consists of three main methods: Nets, Hooks and Wire Traps. Economic efficiency of these methods can be arranged in decreasing order as follows: Wire Traps (4.5), Hooks (3.6) and Nets (1.9).

Economic effectiveness of fishery exploitation in Lake Edku was low (2.6). This was due to increasing fishing costs and decreasing fish production at high variability (80.6%) as a result of densities of the heavy growths of hydrophytes. Consequently development of fishery management in this Lake would necessitate working out of the program, especially as regards fishery exploitation, as well as of proper policy toward lake fisheries.

INTRODUCTION

Owing to the problem of over-population, improvement of animal protein obtained from water resources has become a great necessity especially in Egypt with shortage in animal production, as a result of limited agricultural lands.

Precise economical information is the basis to improve protein supply from water resources, and to predict the economic conditions of fishing industry. The present study is concerned with the economic efficiency of Lake Edku, as an example of the Egyptain lakes, which contributed about 57 % of the total fish catch in Egypt during the period 1962-1983, in spite of bad exploitation of the Lake's fishery.

Study Area

Lake Edku is one of the northern Egyptian lakes. It lies west of the Rosetta Nile branch, parallel to Abu Kir Bay. The area of the Lake was greatly decreased as a result of land reclamation and the remaining areas is about 17,000 Feddans, (Ismail, 1976).

Unlike other lakes, Lake Edku is of shallow depth. About 25% of its area is 50 cm depth and the larger arrea, especially in the eastern part is of smaller depth while the maximum depth does not exceed 150 cm. Large areas are covered with water plants, and the Lake is connected with the sea by Maadya opening (Boghaz). At the same time, many drains open into the Lake causing wide variability in salinity, (Ismail, 1976).

Lake Edku is highly fertile. Its phytoplankton content is 115400 unit/litre. This makes it rich with organic matter necessary for the feeding of small fish. Also the high organic production in the Lake is an indicator for high fish stock, (Salah, 1960 and 1961).

MATERIAL AND METHODS

The materials consisted of the official data, computed from the data of the Central Agency of Public Mobilization and Statistics, and National Institute of Oceanography and fisheries, as also of own data collected from Edku fishermen.

These data were used to analyse the fish catch, gross fish income, quantitative and qualitative structure of the catches, and fishing costs for each fishing method used.

The analysis embraced a period of 1962-1983. Only the fishing costs refer to 1983 as there are no official data published on the fishing costs. Hence, these costs were estimated by personal contacts with the fishermen and Cooperative Society in Lake Edku.

Analysis of data and materials have been used by:

1- Parabolic Curve Trend:-

$$y = a \pm bx \pm Cx^2$$

Where, a , b and c are constants,

y is a real value of the variable in the given year.

2—Maximum or Minimum of Parabola:-

$$b + 2cx = 0$$

hence, $x = b/2 c$

3- Coefficient of Convergence (y^2):-

$$y^2 = \Sigma(y - \hat{y})^2 / \quad y^2 - (\Sigma y/n)^2$$

Where, Coefficient of Correlation (R) equal:-

$$R = \sqrt{1 - y^2}$$

4- Marginal Increments:-

$$Ml = \left[2 \ cx \pm b/\bar{y}\right] \times 100\%$$

Where: $\bar{y}$ arithmetical mean of the variable y.

5- Coefficient of variation (V%):

$$V\% = \sqrt{[\Sigma \ y^2 - (\Sigma \ y)^2/n]} \quad :/y \times 100\%$$

6- Economic efficiency of exploitation:

E F X = Net Fish income: Total Fishing Costs.

Detailed explanation of the above presented methods can be found, in El-Caryony (1986)

RESULTS AND DISCUSSION

Fish Production

Fish production of Lake Edku oscillated from year to year during the period of study. It reached a maximum of 4700 tons in 1964, and a minimum of 400 tons in 1982, with an annual average of 1600 tons (Table 1).

TABLE 1
Evolution of fish production, fish prices, and
Gross fish income in Lake Edku in 1962-1983

Year	Fish Production (Thousand tons)	Fish Prices (Pounds/ton)	Gross Fish income (Thousand pounds)
1962	4.4	500	600
1963	4.4	175	770
1964	4.7	300	1000
1965	4.6	250	900
1966	3.3	210	700
1967	0.3	200	600
1968	1.5	300	500
1969	1.3	300	400
1970	1.2	300	300
1971	0.9	300	300
1972	0.5	300	300
1973	0.7	375	300
1974	1.4	400	400
1975	1.3	600	500
1976	0.9	600	500
1977	1.3	600	500
1978	0.6	600	500
1979	0.6	600	500
1980	0.6	600	500
1981	0.4	600	500
1982	0.4	600	500
1983	0.4	375	500
Average	1.6	400	600

Sources:

Central Agency of Public Mobilization and Statistics
Fishery statistics in ARE - Cairo - page (1962-1983).

Fish production approximated with the paraboilc curve, was characterized by decreasing trend, until it reached a minimum in the 15th year. i. e. about 1976, followed by a continuous increase (Table 2), at high variability (V% = 80.6%). Marginal increments changed from 34.8% in 1962 to + 16.6% in 1983 in relation to the mean level for the period of study, and Coefficient of Correlation (R) between the real and the theoretical values is 0.9231(P = 0.001). (Table. 2).

TABLE 2
Time-series approach of fish production and Gross
fish income in Lake Edku in 1962-1983.

Results	Fish Production	Gross Fish Income
Parabolic Curve *	$Y= 5.733 + 0.670 X + 0.022 X^2$	$Y= 1.491 - 0.235 X + 0.011X^2$
Coefficient of Correlation (R)	0.9231	0.5919
Coefficient of Variation (VX).	80.6	102
Extremum	Min. 1976	Min. 1972
** Marginal Increments (X)	From - 34.8 to + 16.6	From - 21.3 to + 35.6

† P = 0.001 for Fish Production, 0.01 for Gross Fish Income.
† * (X in relation to the mean level).

Species Composition

Level of catches of the four groups of endemic fish species in Lake Edku is presented in (Table 3). The groups can be arranged in a decreasing order as follows: Tilapia species, Clarias species, Mugil species, and Anguilla species, during the period od 1971-1985.

Catches of Tilapia spp. varied between a maximum of 2196 tons in 1984 and a minimum of 360 tons in 1982, with an annual average of 964 tons or about 83.1% of the total prproduction in the Lake, (Table 3).

Catches of Clarias spp. ranged from a maximum of 384 tons in 1985 to a minimum of 30 tons in 1982 with an annual average of 125 tons or about 10.8% of the total production of the Lake, (Table 3).

The highest catches of Mugil spp. were recorded in 1985 (116 tons), while the lowest in 1982 (8 tons), with an annaul average of 48 tons or 4.1% of the total production of the Lake, (Table 3).

Anguilla spp. fluctuated from a maximum of 39 tons in 1985 to a minimum of 3 tons in 1982, with an annual average of 20 tons or about 1.7% of the total production of the Lake, (Table 3).

TABLE 3
Evolution of the catches of particular fish
species in Lake Edku in 1971-1985

Year	Tilapia spp.	Mugil ssp.	Anguilla	Clarias Sap.	Other Sap.
1971	168	96	10	30	3
1972	652	41	11	94	5
1973	800	34	17	76	3
1974	882	84	17	122	3
1975	891	83	17	96	4
1976	735	51	19	68	6
1977	1084	60	35	107	1
1978	968	38	29	87	-
1979	998	50	32	68	3
1980	614	41	32	121	-
1981	370	9	4	58	1
1982	360	8	3	30	-
1983	2137	41	24	206	109
1984	2196	72	30	361	22
1985	2050	116	38	384	6
Average	944	46	29	125	3

* Such as: Labeo spp., Morone labrax, Crabs.

Source
National Institute of Oceanography and Fisheries
Fishery statistics in ARE – Alexandria (1971-1986).

Elements of Fishery Exploitation

Because of the shallow depth and small area of Lake Edku, the operating fishing boats are of small size with fishermen not more than 3 persons in every boat.

Fishing is carried out by different types of gears which are:

1- Trammel nets: most of the catch is composed of Mugil, Tilapia, and Clarias species.

2- Wire traps: most of the catch is composed of Tilapia, and Clarias species.

3- Hooks: most of the catch is composed of Eels, and Clarias speciese.

4- Casting nets: most of the catch is composed of **Mugil, and Tilapia** species.

Besides the previously mentioned fishing gears, some fishermen are using illegal methods for catching fish, (Ismail, 1976).

Gross Fish Income:

The variations in gross fish income from Lake Edku during the period of study were quite high. It reached a maximum of 3,790,000 pounds in 1983, and a minimum of 287,000 pounds in 1969 and 1971, with an annual average of 680,000 pounds during the period of study (Table 1).

It can be stated from the parabolic curve that since 1972 the gross fish income is characterized by growing increments. Marginal increments increase from 0.0% in 1972 (year of the minimum) to + 35.6% in 1983 in relation to the mean level, where the variation of the gross fish income amounted to (V%) 102%. Correlation coefficient between the real and the theoretical values is 0.5919 (P = 0.01), (Table 2).

Fishing Costs

Fishing costs for each method in Lake Edku during 1983 are presented in (Table 4). Fishing costs involve two types of costs: capital costs and operating costs.

TABLE 4
Analysis of Fishing Costs in Lake Edku in 1983.

Category	Number	Price (Pounds)	Useful life (Year)	Fish catch (Tons)	Fish income (Pounds)
1- Fishing Methods					
Nets	1	310	1	1426	2251664
Hooks (90-100 m)	1	125	1	97	153163
Wire	300	450	1	894	1411666
2- Fishing Boats					
Length (5-6 m)	1	500	10		
Length (3-5 m)	1	100	10		

1- Investment and Capital Costs:

Capital investment for each method used in the Lake was valued at a replacement cost and discounted on a straight line basis. Total capital investment amounted to about 828,630 pounds in nets, making an annual depreciation of 368,280 pounds, and amounted to about 37,875 pounds in hooks, making an annual depreciation of 9,825 pounds. In wire traps total capital investment amounted to about 112,750 pounds, making an annual depreciation of 94,300 pounds (Table 4).

TABLE 4 (Continued)

Distribution of Fishing Costs	Nets	Hooks	Wire Traps
1. Initial Capital investment			
Boats	511500	25500	20500
Methods	317130	6375	92250
Total	826630	31876	112750
2. Yearly depreciation			
Boats	51160	2550	2050
Methods	317130	6375	92250
Total	368280	8925	94300
3. Operating Costs			
* Taxes	12276	612	2460
** Insurance	220968	11816	44280
Transporting	71300	4840	44700
Profits	112503	7680	70581
Total	417129	24136	162021
Total Fishing Costs	785407	33061	256321

* 12 pounds per boat yearly

** 3 pounds per fisherman monthly.

2- Operating Costs:

Operting costs for each method embraced taxes, insurance, transporting, and profits to the traders in the markets. Operating costs were estimated about 417,127 pounds in nets, 24,136 pounds in hooks, and 162,021 pounds in wire traps (Table 4).

Total Fishing costs were estimated at about 785,407 poundss for the nets, 33,067 pounds for the hooks, and 256,321 for the wire traps (Table 4).

TABLE 4 (Continued)

Distribution of Fishing Costs	Nets (Pounds)	Hooks (Pounds)	Wire Traps (Pounds)
1. Total Fish income	2251664	153163	1411626
2. Total Fishing Costs	785407	33061	256321
3. Net Fish income (1-2)	1466247	120102	1155306
4. Number of boats	1023	51	205
5. Number of Fisherman	3069	153	615
6. Net income per boat (3:4)	1433	2355	5636
7. Net income per Fisherman (3:5)	478	785	1879
8. Economic efficiency (3:2)	1.9	3.6	4.5

9. Economic efficiency of the lake 3:2 = 2741654 : 1074709 = 2.6

Source:-

1. Personal contacts with fisherman in Lake Edku
2. Cooperative Society of Fisherman in Lake Edku.
3. General authority for Fish Development-Fishery
   Development in Behera Governorate-Cairo-January, 1986.
4. Central Agency of Public Mobilization and Statistics-
   Fishery Statistics in ARE-Cairo- Years 1982-1983.

Economic Efficiency of Fishing Methods

Net Fish income from each method in 1983 was calculated deducing the estimated total costs from the value of Fish harvest (gross fish income) for each method. Net Fish income was about 1,466,247 pounds for nets, 120,102 pounds for hooks, and 1,155,305 pounds for wire Traps (Table 4). Consequently, it can be stated that:

1- Net income per boat was about 1,433 pounds for nets, 2,355 pounds for hooks, and 5,636 pounds for wire Traps (Table 4).

2- Net income per fisherman was about 748 pounds for nets, 758 for hooks, and 1,879 pounds for wire traps (Table 4).

3- Economic efficiency was about 1.9 for nets, 3.6 for hooks, and 4.5 for wire traps (Table 4).

4- Economic effectiveness of the fishery exploitation in Lake Edku is expressed by the difference between value of the fish caught and the costs of exploitation, in relation to these costs, or expressed by net income in relation to the fishing costs. The economic effectiveness was about 2.6 (Table 4).

CONCLUSION

The more general conclusions that can be drawn from this study are:

1- In spite of the surface area of Lake Edku is about 17,000 feddans, but the annual average of fish production from the Lake during the period 1962-1983 was about 1,800 tons, and the general trend of fish production was approximated with a parabolic curve characterized by decreasing increments .it reached a minimum in the 1976, followed by a continuous increase, at high variability (80.6%).

2- Gross fish income of Lake Edku increased tremendously in the period 1972-1983. The parabolic curve is characterized by very high variability (102%). This was due mainly to increasing fish prices and increasing fishing costs.

3- Four endemic fish species are found in Lake Edku, in order of their production: Tilapia species (83.1%), Clarias species (10.8%), Mugil species (4.1%) and Anguilla species (1.7%). These species are quite common in most lakes of Egypt and are the most important commerically.

4- Fishery exploitation in Lake Edku consists of three main methods: the nets, the hooks and the wire traps. Economic efficiency of these methods can be arranged in a decreasing order as follows: wire traps (4.5), hooks (3.6) and nets (1.9).

5- Economic effevtiveness of the fishery exploitation in Lake Edku was low (2.6). Consequently development of fishery management in this Lakle would necessitate working out of the management program, especially as regards fishery exploitation, as well as of proper policy toward lake fisheries.

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