Bull. Nat. Inst Oceanogr. & Fish., ARE, 17 (1) 1991: 37 - 43.

PRODUCTION FUNCTIONS ANALYSIS IN LAKE BUROLLOS FISHERIES.

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ABSTRACT

Fish catch, size of effort and cpue were investigated in Lake Burollos during 1974-1988 period.

Production function analysis was adopted for the period of study on the basis of one year lag analysis.

Fisheries in Lake Burollos was found to be labour intensive. Regression analysis revealed that total number of fishing boats is the important factor in increasing fish catch from the Lake. It is suggested to limit any further license to fishermen and to expand and modernise the existing fishing boats, together with re-distributing the existing man power, and substituting four to five fishermen for each new boat. The new boats are suggested to be small units of second or third degrees of inland firheries type.

INTRODUCTION

Lake Burollos is the second largest Delta lake in Egypt. Its area is about 33% of the total area of the Delta lakes and about 6% of total area of inland fisheries in Egypt. The number of fishermen engaged in the Lake fisheries in 1988 amounted to about 20.4 thousand men which is about 42% of fishermen in Delta lakes, and about 18% of total fishermen in inland fisheries in Egypt. The number of boats in the Lake fisheries in 1966 amounted to about 6.6 thousand boats which is about 42% of boats operating in the Delta lakes and about 20% of total boats operating in inland fisheries in Egypt. (Table 1.).

It can be seen that economic fishery resources allocated for fish production in Lake Burollos are proportionally bigger than those in other delta lakes. However, catch per unit efforts (cpue) attained from the Lake in 1988 is found to be low compared to corresponding cpue in other Delta lakes and even in other inland fisheries in Egypt.

It is revealed from table 1 that, the fish catch from Lake Burollos in 1988 amounted to about 22% of total fish catch from the Delta lakes and about 15% of total catch from inland fisheries in that year in Egypt. Productivity of one feddan (cpue) from the Lake in 1988 was about 213 kg of fish, productivity of one fisherman in that year was about 1.1 tons of fish and productivity of one boat was about 3.7 tons of fish. These values are lower than those in the case of individual fisheries or in the case of general average productivities in Delta lakes, (Table 1.).

Table 1.

Relative Importance of Lake Burollos fisheries in Egyptian Inland* Fisheries in 1199.

	Fish Catch Thousand Tons	%	%	Water Area Thousand Feddans	%	%	Fishing Effort Thousand Fishermen	%	%	Thousand boats	%	%	CPUE Kg./ feddan	tonn/ man	tonn/ boat
Delta Lakes															
Manzalah	96.3	63.7	41.9	195.0	57.2	10.9	17.2	33.6	15.4	5.651	35.6	16.6	355.4	4.0	12.3
Burollos	24.3	22.4	14.7	114.0	33.4	6.4	20.4	42.2	18.2	6.612	41.7	19.5	213.2	1.1	3.7
Edku	8.2	7.5	5.0	17.0	5.0	1.0	6.8	14.1	6.1	1.327	8.4	3.9	482.3	1.2	6.2
Mariout	6.9	6.4	4.2	15.0	4.4	0.9	3.9	8.1	3.4	2.264	14.3	6.7	460.0	1.8	3.0
Total	108.7	100.0	65.8	341.0	100.0	19.2	48.3	100.0	43.1	15.854	100.0	46.7	318.8	2.3	6.9
Inland Lakes															
Bardweel	1.5		0.9	167.0		9.4	2.4		2.2	0.723		2.1	9.0	0.6	2.1
Quaroni	1.9		1.1	90.0		5.1	6.2		5.5	0.763		2.3	21.1	0.3	2.5
Asuan	21.9		13.3	1000.0		56.3	11.9		10.6	2.253		6.6	21.9	1.8	9.7
Total	25.3		15.3	1.257.0		70.8	20.5		18.3	3.739		11.0	20.1	1.2	6.3
River Ni	31.2		18.9	173.0		10.0	43.2		38.6	14.363		42.3	175.3	0.7	2.2
Grand To	165.2		100.0	1.776.0		100.0	112.0		100.0	33.956		100.0	93.0	1.5	4.9

Source: Collected and Calculated from: * Fish Farms are not included.

1- The Central Agency for public mobilisation and statistics, 1988. Year-book of the fishery statistics in Egypt. Cairo

2- A. F . El-Karachily, et al., 1988.

Aim of study:

1- To review catch, effort and productivity of unit effort in Lake Burollos during 1974-1988 period.

2- To estimate statistically the effect of size of effort on fish production from the Lake during the period of study.

Results of the study might be useful in improving and developing fisheries in the Lake and in determining the main factor of fish production.

MATERIAL AND METHODS

To achieve the first aim of study index numbers will be calculated to study evolution of fish catch, inserted effort (number of men and number of boats) and corresponding cupe (ton/man and ton/boat).

To achieve the second aim of study production functions analysis will be adopted. Multiple regression economic models will be designed and the following equations will be be estimated (Heady, 1961 and Johnston, 1960).

- Linear production function:

$$Y = a + b_1 X_1 + b_2 X_2$$

- Double log production function:

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2$$

Where a, b_1 and b_2 are equation parameters, X_1 = number of fishermen and X_2 = number of boats.

As to specific nature of fishery exploitation, statistical analysis will be done on the basis of one year lag, i.e., to relate catch in given year, with size of effort in the former year.

Data needed for the study were collected from fishery statistical year-books issued by he Centeral Agency of Public Mobilization and Statistics (CAPMAS) and by the General Authority for Fish Resources Development (GAFRD).

RESULTS AND DISCUSSION

1- Evolution of Catch, Effort and C.P.U.E:

Table 2 reveals catch, effort and cpue in Lake Burollos during 1974-1988 period. It can be seen that:

Fish catch from the Lake has increased from about 4.9 thousanad tons in 1974 to about 24.3 thousand tons in 1988, with an average increase equal to about 1.39 thousand tons annually. Index number has raised from 100 in the base year (1974) to about 480 in 1988, with an average increase equal to about 27.14% annually.

Table 2.

Catch, Effort and Catch per Unit of Effort (CPUE) in Burollos for the period 1974-1988.

C a t c h			E f f o r t				C. P. U. E			
Year	tons	Index number	Fishermen number	Index number	Boats number	Index number	ton/ man	Index number	ton/ Boat	Index number
1974	4875	100	8611	100	2853	100	0.566	100	1.709	100
1975	5469	112	8436	98	2812	99	0.648	114	1.945	114
1976	6573	135	4338	98	2811	99	0.779	138	2.338	137
1977	6587	135	8532	99	2844	99	0.772	136	2.316	136
1978	6514	134	8544	99	2848	99	0.762	135	2.287	134
1979	7018	144	8505	99	2835	99	0.825	146	2.475	145
1980	7137	146	8496	98	2832	99	0.840	148	2.520	148
1981	6742	138	8385	97	2795	98	0.804	142	2.412	141
1982	7273	149	7530	87	2790	98	0.966	171	2.607	153
1983	8205	168	8730	97	2780	97	0.980	173	2.951	173
1984	9854	202	8361	97	2787	98	1.179	208	3.536	207
1985	11947	245	23382	272	7709	270	0.511	90	1.549	91
1986	19908	408	23571	274	7810	274	0.845	149	2.549	149
1987	22510	462	12792	149	4264	149	1.760	311	5.279	309
1988	24274	480	20424	237	6612	232	1.189	210	3.671	215

Source: Collected and caculated from:

1- Central Agency of public Mobilisation and Statistics, 1974-1988.Year-book of Fishery Statistics in Egypt. Cairo, Egypt.

2- General Authority for Fish Resources Development, 1986-1988, Bulletin of fish catch from Egyptian fisheries, Cairo, Egypt.

The number of fishermen has increased from about 8,611 men in 1974 to about 20,424 men in 1988, with an average increase equal to about 843 men annually. Index number has raised from 100 in the base year to about 237 in 1988, with an average increase of about 9.79% annually.

The number of boats has increased from 2,853 boats in 1974 to about 6,612 boats in 1988, with an average increase equal to about 269 boats annually. Index number has raised from 100 in the base year to about 232 in 1988, with an average increase of about 9.43% annually.

The productivity of one fisherman has been nearly doubled from about 0.6 ton in 1974 to about 1.2 tons in 1988, with an average increase equal to about 45 kg of fish annually. Index number has raised from 100 in 1974 to about 210 in 1988, with an average increase equal to about 7.9% annually.

Likewise, productivity of one boat has been doubled from about 1.7 tons in 1974 to about 3.7 tons in 1988, with an average increase equal to about 0.14 ton annually. Index number has raised from 100 in 1974 to about 215 in 1988, with an average increase of about 8.2% annually.

2- Production Functions Analysis:
2.1 The Linear Form

The following equation has been estimated

$$Y = -805.589 - 1.830\ X_1 + 8.593\ X_2 \qquad (1)$$

$$(0.303)^{xxxx} \quad (1.509)^{xxx} \quad (2.319)^{xx}$$

$$t\ (...) \quad r = 0.8139 \quad r^2 = 0.6626 \quad F = 11.7776^{x}$$

x Significant at 0.01 Probability level.

xx Significant at 0.05 Probability level.
xxx Significant at 0.10 Probability level.
xxxx not Significant.

The F value was significant at 0.01 probablility level which indicate that the regression equation is significant. The Co-efficient of determination (r^2) was equal to 0.6626 which means that about 66% of the total variation in fish catch (Y) was explained by number of fishermen (X_1) and number of boats (X_2).

The effect of number of fishermen (X_1) on fish catch (Y) was significant at 0.1 probability level. The estimated regression coefficient was negative, indicating that an increase of fishermen by one additional man will decrease annual catch by about 1.83 tons. This means that increasing the existing number of fishermen in Lake Burollos will negatively affect its productivity resulting in a decrease in its total fish catch.

The effect of number of boats (X_2) on fish catch (Y) was significant at 0.05 probability level, an increase of number of boats by one additional unit is estimated to increase annual catch by about 8.6 tons.

Fish catch from the Lake was found to be positively and highly correlated with number of boats (X_2) than the case with number of men (X_1). The calculated partial correlation Co-efficients were (+0.7389) and (-0.7424) respectively.

The marginal rate of technical substitution (M R T S)$^{\#}$ of the two factors (X_1 , X_2) calculated from the equation number (1) was equal to -4.70

$$* \text{ MRTS} = \frac{\partial Y}{\partial X_1} \div \frac{\partial Y}{\partial X_2} = \frac{X_2}{X_1} \quad \frac{0.593}{-1.830} = -4.7$$

2.2 The Log Form

The following equation has been estimated

$$\log Y = 1.235 - 1.671 \log X_1 + 2.867 \log X_2 \qquad (2)$$

$$(0.351)^{xxxx} \quad (1.193)^{xxx} \quad (2.008)^{xx}$$

$$t\ (...) \quad r = 0.8227 \quad r^2 = 0.6769 \quad f = 12.5670^{x}$$

x Significant at 0.01 Probability level.
xx Significant at 0.05 Probability level.
xxx Significant at 0.10 Probability level.
xxxx not Significant.

The results of this equation agree with the results of equation number (1), the calculated f value was significant at 0.01 probability level. The Co-efficient of determination (r^2) was equal to about 0.6769, which means that (X_1) and (X_2) explain about 68% of total variation in (Y).

The increase of total number of fishermen by 10% is estimated to decrease annual fish catch by about 17% , on the other hand the increase of total number of boats by 10% is estimated to increase annual fish catch by about 29% .

SUMMARY AND CONCLUSIONS

The fish catch, size of fishing effort (fishermen, boats) and the corresponding cpue has been increased in Lake Burollus fisheries over the period of study, which may indicate abundance of fishery resources. The Lake was found to be labour intensive. Total number of fishermen has been raised by about 137% over the period of study, with an average increase equal to about 843 men annually. About 42% of total fishermen in the four Delta lakes in 1988 was engaged in Lake Burollos only.

Statistical analysis of production functions revealed that total number of fishing boats is the important factor in increasing fish catch from the Lake. The catch was found to be positively and highly correlated with total number of boats. Contrarily, negative and highly correlation was found between fish catch and total number of men. The analysis revealed that an increase of total number of boats by 10% is estimated to increase fish catch from the Lake by about

29%, on the other hand, an increase of total number of fishermen is estimated to decrease annual catch by about 17%.

It is suggested to limit any further license to new fishermen in Lake Burollus fishery, and to expand and modernise the existing fishing boats* together with re-distributing the existing manpower to operte the new boats. New boats are suggested to be small units of second or third degrees. This will result in higher labour productivity and increasing fish catch from the Lake. From the calculated marginal rate of technical substitution, it is recommended to re-distribute four to five fishermen for each new boat.

ACKNOWLEDGEMENT

The author wishes to thank Dr., Sayed M. El-Sharkawy for his valuable assistance.

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* Fishing boats in Egyptian lake fisheries are un-motor units of three degres:
- First degree: with crew up to 12 men.
- Second degree: with crew up to 6 men.
- Third degree: with crew up to 3 men.

(CAPMAS, 1974-1988).