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IMPROVEMENT OF HOSHA FISH FARMING METHOD TO PROTECT THE LAKES' FISHERIES IN EGYPT

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ABSTRACT

Hosha is a local Egyptian name for a unique form of fishing technique generally operating as a fish harvesting method in the Egyptian delta lakes. Results revealed that, the rapid replacement of the Hosha practices by means of modern techniques of fish culture will not only increase fish production, but also will certainly protect the natural resources from over-fishing and the aquatic environment from pollution. Also, the positive features of Hosha farming will be picked up readily by fish farmers if credit facilities and long-term leases are provided.

INTRODUCTION

A Hosha is an enclosure built by muddy dykes in the low lying ground, with one or several narrow opening, connecting it to the open lake . A satisfactory fluctuation of the water level must be present in order to fill the enclosure with water. The water flows into the enclosure through the openings, and the fish enter with water current. Periodically, the openings are closed, and the enclosure are then pumped to dry, and the fish are harvested . This method of fishing may be repeated several times during the year . This system occupies about 25-32 thousand feddan, i.e. about 13.4% of the area of Lake Manzalah (ALMP, 1995) which is the largest of the Nile Delta lakes covering an area of 213,440 feddans, and it provides about 30% of the domestic fish supply (El-Shebly, 1994). It is located at the North eastern region of the Nile Delta (Fig. 1).

Most of the water received by the lake comes from the drains, especially Bahr El-Bakar, Hadous, Matariya, El-Serow, Faraskour, Inaniya, El-Ratama, El-Soffera, Port Said and El- gamil outlet (Fig.1). Bahr El-Baker drain bring about 110 million cubic meters / month to the lake, while Hadous and Ramsis drains about 170 million cubic meters / month collectively. These drains are heavily contaminated by sewage and industrial wastes (Ramdan & Hashem, 1993 and El-Shebly, 1994).

The Hosha system has many disadvantages: one of which is the destruction of fish populations in Lake Manzalah through filtration where only one fourth of the Hosha yield is suitable for human consumption and the rest is used for animal feeds. Therefore, in recent years it has been observed that the total annual fish yield of the lake is tremendously decreased due to high levels of industrial, agriculture and sewage pollution, and the expansion of illegal Hosha practices in the lake. Accordingly, fishery management through increasing of aquacultural production in Lake Manzalah is a must. Great use of water resources of the lakes in aquaculture practices will certainly protect the aquatic environment from pollution because water resources will be under control (FAO, 1983 and 1987; Yao and Abdel-hamid Kidam, 1988 and Salama ***et al.***, 1989).

Thereby, the present work aims to study the present status of Hosha practices in Lake Manzalah and discusses the possibilities of improving the Hosha farming system by means of modern techniques of fish culture as well as to solve the problem of the illegal fishing methods.

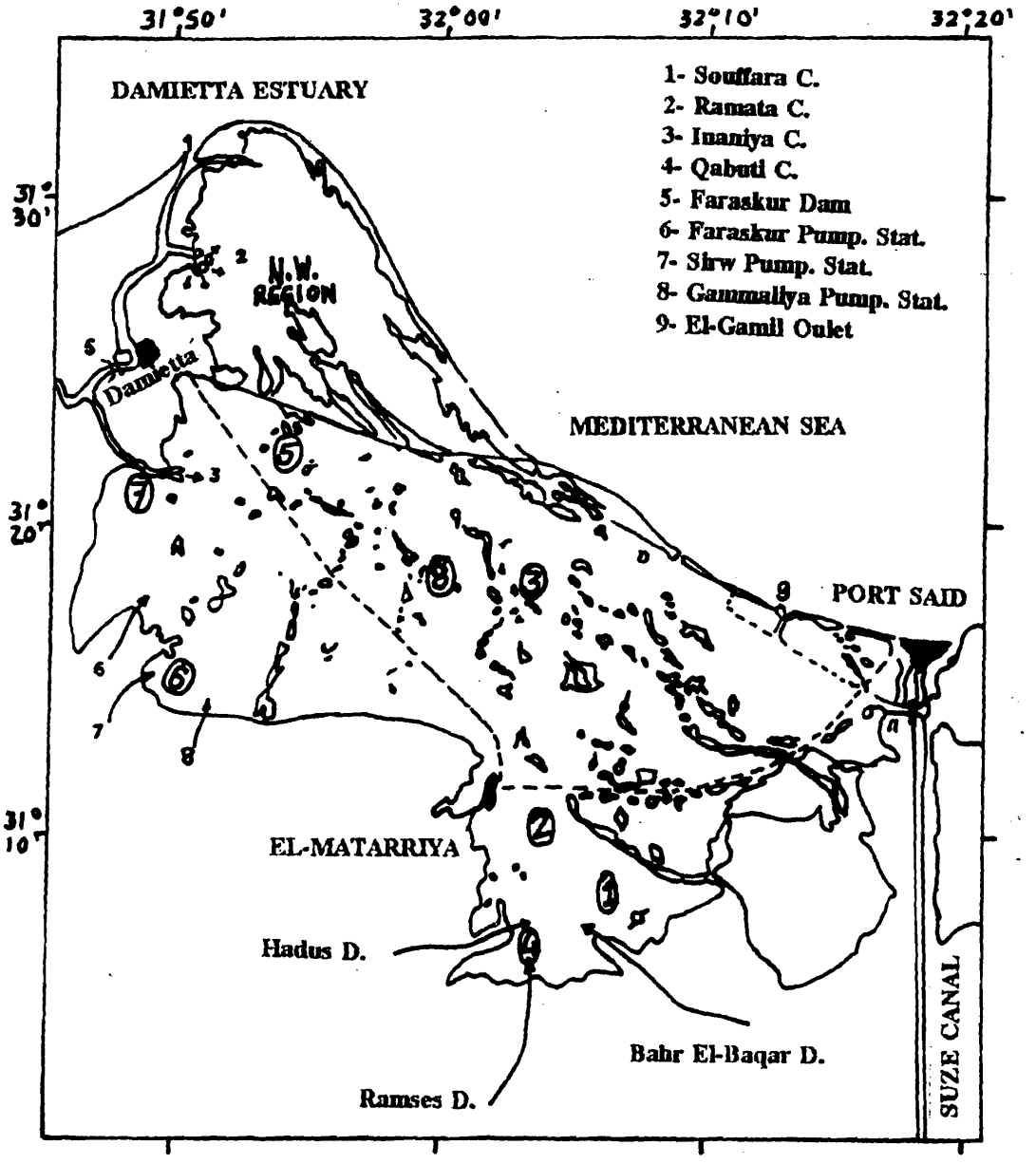

Fig.(1): Map of the Manzalah Lake, and the locations of the eight Hosha investigations during the present study.

MATERIAL AND METHODS

For the present study, eight Hoshas were selected, three of which in the eastern region, one in the middle region, one near the western and three in the western region. These Hoshas were selected on the basis that they are quite different (Fig. 1).

The field trips and research activities were conducted through an integrated research project during the period from 1991 to 1995 to meet the fishery and irrigation experts as well as the owners or farmers of the exiting Hoshas in the lake, to collect all needed data for evaluation of the present Hosha practices and to prepare a plan for replacing Hosha farming by means of modern techniques of fish culture.

To evaluate the various environmental conditions in different Hosha areas, the physico-chemical parameters (water temperature, turbidity, pH, dissolved oxygen, alkalinity, salinity, hardness, nitrate, phosphorus and heavy metals) were determined according to American P ıblic Health Association (1965); Golterman *et al.* (1978) and Allen *et al.* (1979).

The survey was also used to determine the effect of infection or diseases on fish production in the different Hosha areas as a result of the progressive increase of industrial drainage water inflow and sewage which turned some areas of the lake to be highly polluted habitat and that might in turn affect the water quality and fish production not only in the lake proper, but also in the Hosha systems.

RESULTS AND DISCUSSION

1- Evaluation of the present Hosha practice in Lake Manzalah :

About ten thousands Hoshas are present in Lake Manzalah covering approximately 26,250 feddans (feddan=4200 m^2) . Many Hoshas are located on private land, but the disposal of water surfaces rests with government, few are leased from government (500 Hoshas in Dakahlia and 300 in Damietta Governorates) on short-term leases for five years.

Hosha management is very simple. Between May and August, when the water level of the lake is high due to increase of water discharge from the agriculture irrigation system, the Hoshas are opened. Seeding take place naturally (fish fry, fingerlings and marketing sizes) with Tilapia, grey mullet, catfish, eel, etc. The growing period is short, and harvesting is carried out several times until January. According to Ishak and Shafik (1982) only one fourth of the total fish yield is suitable for human consumption while the smaller fishes are used for animal feeds. Therefore the value of the crop is greatly reduced.

Hosha practice activities can be classified into three types, as follows:

i- The first type of Hosha

It constitutes about 68% (approximately 17,000 feddans) of the total Hoshas area in Lake Manzalah. It is used by fishermen as fish catch areas. When the Hosha is opened or by using a big water wheel revolved by power motor; various sizes of different species enter naturally in the Hosha. After 2-3 weeks the fishermen drain the Hosha and catch the fish by hand nets or by a seine net. This operation is repeated every 3 or 4 weeks during the period from May to January.

As a result, this type of Hosha which is commonly used in the Eastern and middle regions of the lake causes a great harmful effect on the fish resource of Lake Manzalah because more than 75% of the total catch are of small-sized fish (less than 10 cm. length) mostly of ***Tilapia zillii***.. The Eastern and middle regions of the lake are characterized by a low salinity (1.27-2.85 g/l) and high turbidity (Table 1) due to receiving industrial waste and sewage effluents from Bahr El-Bakar, Ramsis and Hadous drains (Fig. 1), and the increased of phytoplankton density in the middle region . Also, the lowest average dissolved oxygen was recorded in Hosha area at the south eastern region (4.4 mg/l) due to high discharge of polluted water that consumes high amount of oxygen for organic matter decomposition .

Results obtained are in agreement with the observations of Hepher and Pruginin (1981) and El-Shebly (1994). The results in Table (1) did not show any differences in temperature and pH between the two regions of the first type of Hosha. In contrast, the average dissolved oxygen in the Hosha area at the

middle of the lake was high (7.8 mg/l) as a result of high photosynthetic activity owing to the high content of phytoplankton in this area. This is in agreement with the statements of Beltagy (1985) and Hassan (1995). Table (1) indicates also that, the water in the first type of Hosha area is productive and reflects also their supereutrophic status. Huet (1972) pointed out that, the alkalinity above 50 mg $CaCo_3$/l indicates productive water and that above 65 mg $CaCo_3$/l is the most productive. Samaan and Abdallah (1981) stated that, thepolluted water have high alkalinity. The results of nitrite, nitrate, total nitrogen, phosphorus and heavy metals in the south eastern region water (Table 1) is an indication of its contamination. This forms a public health problem as the area is influenced mainly by Bahr El-Bakar drain . These findings are nearly in agreement with the previous work of Dowidar and Abdel-Moati (1983); El-Ghobashy (1990) and El-Shebly (1994) on Lake Manzalah .

The water quality criteria in the middle region (Table 1) are regarded as most suitable for fish survival and production. The relatively higher amounts of nitrite, nitrate, total nitrogen and phosphorus when compared with those of the Western region, is mainly due to the influence of agriculture drainage water and partly to sewage discharged into the lake through Matariya drain (Fig. 1).

Data in Table (2) present fish yield from some of the first type of Hosha in the eastern and middle regions in Lake Manzalah. It was found that the total fish yield/feddan was very low, ranged between 45-75 kg/feddan/year. However, only 25-30% of the total yield is suitable for human consumption; while 60-65% is of smaller fishes (***T. zillii***), 15-20 fish/kg and 10% catfish, ***Clarias lazera***.

Table (1) : Water quality criteria at Lake Manzalah hosha areas.

Parameters	*South-estern region*	*Middle region*	*Near western region*	*South-western region*
Air - Temperature (^{o}c)	22.85 ±7.02	22.77 ±6.94	22.68 ±7.00	22.88 ±6.99
Water				
- Turbidity (cm)	21.05 ±6.32	20.60 ±6.20	21.08 ±6.34	20.96 ±6.19
- Ph	21.75 ±3.36	21.58 ±4.32	37.50 ±6.63	31.o4 ±5.35
- Dissolved oxygen (mg/l)	8.25 ±0.21	8.22 ±0.28	8.33 ±0.24	8.51 ±0.31
- Total alkalinity (mg/lcaco$_3$)	4.44 ±0.87	7.78 ±2.74	6.23 ±1.04	8.56 ±1.38
- Salinity (g/l)	190.74 ±55.79	165.14 ±38.28	219.60 ±65.35	219.03 ±66.07
Ca^{++}	1.27 ±0.35	2.58 ±1.62	6.067 ±3.64	1.00 ±0.48
- Hardness (mg/l)	66.15 ±5.17	74.66 ±12.93	57.61 ±9.43	32.66 ±4.37
Mg^{++}				
- Nitrite (mg/l)	78.32 ±9.17	166.52 ±47.50	280.24 ±69.77	67.76 ±12.31
- Nitrate (mg/l)	0.034 ±0.017	0.014 ±0.007	0.012 ±0.005	0.013 ±0.009
- Total nitrogen (mg/L)	0.679 ±0.107	0.430 ±0.138	0.203 ±0.101	0.305 ±0.145
- Phosphorus (mg/l)	5.636 ±2.393	3.563 ±1225	2.805 ±1.804	3.924 ±1.344
- Heavy metals (mg/l)	1.423 ±0.809	1.006 ±0.657	0.572 ±0.444	0.508 ±0.346
Zinc				
Copper	0.038 ±0.008	0.015 ±0.007	0.013 ±0.006	0.017 ±0.010
Iron	0.038 ±0.019	0.033 ±0.012	0.023 ±0.011	0.032 ±0.019
Lead	0.302 ±0.203	0.213 ±0.012	0.145 ±0.087	0.201 ±0.103
Cadmium	0.408 ±0.187	0.260 ±0.406	0.344 ±0.330	0.393 ±0.320
	0.022 ±0.006	0.017 ±0.011	0.018 ±0.011	0.015 ±0.006

Results in Table (2) showed also the effect of industerial and agriculture drainage water as well as sewage discharge, on the Hosha fish yield. The lower values of fish yield (45-56 kg/feddan/year) were recorded in Hosha No. 1 and 2 that receive industrial wastes and domestic sewages in the south eastern region neighbouring Bahr El-Bakar, Ramsis and Hadous drains. While the corresponding results in Hosha No. 3 that receives mainly agriculture drainage water and little sewage in the middle region neighbouring Matariya drain was 75 kg/feddan/year.

The intensive survey of parasites in the first type Hosha's areas was used to study the relation between the physico-chemical environmental conditions and infection density and fish production. It was indicated that the total catch of Hosha's fish in the southern eastern region was very low due to the high level of domestic and industrial wastes . This is reflected on the fish in terms of diseases that include : Viral, Bacterial, Fungal, Protozoan, Trematodes, Nematodes, Cestodes and Acanthcephalen infections.

The present study showed also that fish belonging to the genera ***Clarias*** and ***Tilapia*** collected from different Hosha have similar susceptibility to monogenean infections. It was noticed also that the higher prevalence and infections in the south eastern region's Hosha, neighbouring Bahr El-Bakar, Ramsis and Hadous drains, as compared with those in the middle region as observed by Al-Basil (1990) and El-naggar (1995).

ii- The second type of Hosha

It constitutes about 22% of the total Hosha area in Lake Manzalah (approximately 5,800 feddans). It is used as extensive fish farm in a part of the Hosha and as a catch area for the lake's fish in the other part . This type is wide spread in El-Saila (west of the lake), Dameitta Governorate and El-Serow (south western of the lake), Dakahlia Governorate .

Table (2): Examples of management plans for the first type of hosha practice in Lake Manzalah.

Names	Location and area	*Stocking data*		*Harvesting*			Labour No. hosha	Ownership
		Month	Density and species (Specimens/fed.)	Total harvest/ cycle/fed. (kg)	No. of cycle /year	Total harvest (kg/fed./year)		
Tamim Abdel-Razik (1)	Bahr El- Bakar, East of the lake, Dakahlia, Governorate 25 feddans	May	800 tilapias from different sizes and species of catfish, *C. lazera*	7.5	6	45	11	Rent from GARD* by 20 L.E./fed. (before 1975)
El-konisa (2)	Near Salam son, East of the lake, Dakahlia Governorate, 30 feddans	April	1000 tilapias and unknown no. of *C. lazera*	8.0	7	56	2 families, about ten persons	Rent from GARD by 20 L.E./fed.
Mohamed K. Tawfik (3)	El-Legan, Middle of the lake, Dakahlia, Governorate 20 feddan	May	1000 tilapias and unknown no. of *C. lazera*	10.7	7	75	One fami;y, about 6 persons and 3 persons part time	Rent from GARD by 50 L.E./fed. (after 1975)

*** GARD : General Authority for Aguatic Resources Development.**

The management of the second type of Hosha practice includes :

* By using a big water-wheel to lift the water from the lake to the catch area of the Hosha (30-50% of the total Hosha's area); various sizes of different species (mostly ***T. zillii*** and ***C. lazera***) enter the Hosha's catch area .

* After 10-15 the catch area is drained completely . The small fish (less than 10 cm length, of different ***Tilapia*** species) are transported directly to a specially prepared ponds (growing or fatteningg ponds 50-70% of the Hosha's area) until they reache the market able size. The depth of the water varies between 1.0-2.5 m. These ponds are stocked also with mullet fry and fingerlings, (***Mugil cephalus and M. capito)***.

* Organic fertilizers are used to increase the water fertility in the ponds . Some times, little supplementary feeding (18-20% protein) are used .

* The growing period is 6-8 months starting from May-June .

From Table (1), it is clear that, the water quality criteria in the western and south western region are slightly different with the exception of salinity which was higher in the western region (6.0-6.7 g/l) than those in the south western one (1.0 g/l) . Results revealed the suitability of the water for fish survival and production, whereas the secchi-disc reading were 37.50 cm. and 31.04 cm. in the western and south western region, respectively. Therefore, these areas are moderate in phytoplankton and detritus density (El-Shebly, 1994); the pH values were always in the alkaline side; the dissolved oxygen was not less than 6.0 mg/l. There were also no nutrient limitations and the average concentrations of heavy metals in the water were relatively low compared with those in the south eastern region (Huet, 1972; Hepher and Pruginin, 1981; Essa ***et al.***, 1989). These results may be attributed to the western and south western regions that receive mainly agricultural drainage water neighbouring Inaniya, Faraskur and Serow drains and little sewage or domestic wastes (Fig. 1).

As a result of the suitability of the water in the second type of Hosha practice regions, the following advantages were depicted:

1) The fish yield from the second type of Hosha practice was higher than that of the first type of Hosha practice (Table 3). It was about 47-75 kg/feddan/year in the catch area, as well as about 120-185 kg/feddan/year from the farmed section in the same Hosha by using organic fertilizer in addition to little supplementary feeds. Rappaport ***et al.*** (1978); Hepher and Pruginin (1981) reported that, the highest fish growth and yield are achieved by using fertilization and supplementary feeds.

2) The pathological survey showed the absence of Cestodes and Nematodes from both Tilapia and mullet, and the Acanthocephala from ***Clarias***. But, there are a distinct variation in prevalence of all helminth parasites between fish from different Hosha areas as reported by El-Naggar (1995) .

iii- The third type of Hosha

It constitutes about 10% of the total Hosha's area (approximately, 2,630 feddans). It is used as fish pond culture. In the third type of Hosha practice production of food-fish weighing between 100-500 g is a traditionally carried out using fingerlings which have been raised in a fattening pond for several months (8-12 months). The most widely used farming system is polyculture, using complementary species, organic fertilization of the water and supplementary feeding. The number of species used in polyculture generally varies between two and three, although the current trends is to increase the number. The farmers in the Hosha are also breeding cows, poultry and goats with fish and agriculture.

The third Hosha type practice management includes :

* In May, fish polyculture (Tilapia, mullet, carp and others) are reared in fertilized ponds (only organic fertilizer, 100-150 kg/feddan/year) .

* Traditional devices for pumping water (water wheel) or mobile pumps are used to raise the water into the main irrigation canal of the farm which supply all the ponds. The pond water are totally drained once a year by pumping or gravity.

Table (3): Examples of management plans for the second type of hosha practice in Lake Manzalah* .

Names	Location and area	*Stocking data*		*Harvesting*			Total production per hosha (kg/fed./year)	Labour No./hosha
		Month	Density and species (Specimens/fed.)	No. of cycle in catch area/year	Total harvest in catch area/year	Total harvest fish ponds (kg/fed./year)		
El-said Tawfik El-Halafawi (4)	Bahr El- Bakar, Dakahlia, Governorate 30 feddans: 24 fed. catch areas and 6 fed. fish pond, slightly Brakish	May	800 tilapias from different sizes and unkown No. of *C. lazera* / feddan in catch area * stocking rate in fish ponds: 3000 tilapias fingerlings/fed.	7	47	120 without supplementary feeding, only they used organic fertilizer	167	5 full time, 20 part time during harvesting
El-Amyra Esmail Alosm (5)	El-Saiala West lake, Damietta Governorate, fresh water 105 feddan: 20 fed. catch areas, plus 85 fed. divided into two ponds	April	1000 tilapias and unknown no. of *C. lazera* /feddan in catch area . 2000 tilapias fingerlings+1000 mullet *M. cephalus* and *M. capito* /feddan in fish ponds	7	75	185 by using: organic and inorganic fertilizer-supplementary feeds (18-20% protein)	260	10 full time, 20 part time during harvesting

*These areas are rented from GARD by 20 L.E./fed./year . The fish prices are 3 L.E. /kg tilapias at different sizes . 7 L.E./kg mullet and 2.5 L.E./kg catfish .

* The surface areas of the growing or fattening ponds vary from 5 to more than 20 feddans. However, earth ponds of 2-10 feddans are preferred because the difficulty of managing the large ponds and the fish do not receive sufficient amounts of food .

* Stocking rate in the polyculture at the most Hosha farming : 1000 carp (*Cyprinus carpio*) + 1000 Tilapias + 200-250 mullet (***M. cephalus* or *M. capito***)/feddan . Ideally, the total stocking rate in the growing ponds lies between 3000-5000 fingerlings / feddan .

* Supplementary feeding containing 11-17% protein is usually used according to the type of feeds given (rice bran, cotton seed cake, soya bean cake, bread crumbs, fish or shrimp meals, blood meal....etc.) . The feeding rate ranged between 2-3% of fish body weight/day for 3-6 days a week depending on the availability of feeds in the market, its prices and water temperature .

* At the end of the fattening period, 8-12 months, the harvest is carried out after partially draining or complete draining.

The third type Hosha practice is widespread in El-Serow, Inaniya and El-Saila areas at the west of the lake which has the most suitable water quality (Table 1) and lowest fish infections.

The annual fish yield from most of the Hosha farms ranged between 400 to 450 Kg/feddan/year (Table 4). The major problems at the moment in Hosha farming are : lack of information on the biology and husbandry of suitable species being farmed; lack of information on the adequate fish feed used; lack of skilled personnel and financial resources, controlling predatory fish and the shortage supply of mullet and Nile tilapia, (***Oreochromis niloticus***) fries.

2- <u>The Possibilities of Improving the Hosha Farming System</u> :

Converting the Hosha areas into fish farms, can help in producing more animal protein and can solving the problem of illegal fishing methods of Hosha that result in overfishing of natural resources

Table (4): Examples of management plans for the Third type of hosha practice in Lake Manzalah.

Names	Location and area	Stocking		Harvesting and production data				Labour
		Month	Density and species (Specimens/fed.)	Av. fish weight at harvest (g)	Total production* kg/fed.	Mortality (%)	Duration (Month)	
Mohamed Maati (6)	**El-Serow, South west of the lake, Dakahlia, Governorate 30 feddans**	**May**	**1000 carp +1000 tilapias + 250 mullet (2250 fingerlings/fed.)**	**(100-550) tilapias: 100-180 mullet:120-150 carp:250-550**	**465 tilapias: 112 kg mullet: 38 kg carp: 320 kg other: 5kg**	**25**	**10**	**5 full time, 5 part time during harvesting**
El-Enania Mokhtar M. El Kzaz (7)	**El-Enania, West Damietta Governorate 20 feddan**	**May**	**1000 carp +250 mullet + 600 tilapias (1850 fingerlings/feed.)**	**(100-500) tilapias: 150-200 mullet:150-180 carp:250-500**	**408 tilapias: 87 kg mullet: 33 kg carp: 280 kg other: 8kg**	20	10-12	3 full time, 5 part time during harvesting
Mosad El-Said El-Swidi (8)	El-Saiala, Damietta Governorate 20 feddan	May	1200 carp + 200 mullet + 800 tilapias (2200 fingerlings/fed.)	**(100-500) tilapias: 100-150 mullet:150-180 carp:200-500**	**453 tilapias: 80 kg mullet: 26 kg carp: 336 kg other: 11kg**	25	10-12	3 full time, 5 part time during harvesting

* Others : mainly catfish ***C. lazera***.

For the present Hosha development, several procedures had to be applied:

1- Maintenance of the barriers.
2- Annual stocking of a suitable initial fish size (5-7 cm. length).
3- Control of predatory fish by means of intensive fishing or selective fishing .
4- Polyculture of a large number of complementary fish species, up to 3 species, mullet, tilapia, some shrimp and sea bream (***Sparus aurata***).
5- Regulating water level. Pumping will be necessary both for filling and for drainage of Hosha ponds.
6- The supplementary feeding should include 25% crude protein, 6% crude fat, not more than 6.7% crude fiber and the energy value must reach 3200 k. cal/kg diet.
7- Fertilization by using organic and inorganic fertilizers to increase water productivity.
8- Regulating the minimum size of fish harvested.
9- Harvesting the food-fish in the slow growing season (winter) .
10- Intensifying the fishing rate of the pond to over 90% before completely drain
11- Establishing a spawning and nursing ponds in Hosha farms.

In conclusion, the rapid replacement of the Hosha practices by means of modern techniques of fish culture not only increase fish production to at least 767 kg/feddan but also indicates a high degree of investment in fish farming . Essa ***et al.*** (1989) reported that, the availability of natural and supplementary feed resulted in a significant increase of fish growth and production (1917 kg/ha./year) . It is also to be expected that the positive features of this type of farming will be picked up readily by farmers if credit facilities and long-term leases are provided . In addition, the use of water resources in aquaculture practice will certainly protect the aquatic environment from pollution because water resources will be under control .

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