

## Will the New Large-Scale Aquaculture Projects Make Egypt Self Sufficient In Fish Supplies?

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### ABSTRACT

Aquaculture has been known in Egypt since the beginning of written history; tomb friezes date back to 2500 B.C. and illustrate the harvest of tilapia from ponds. Modern aquaculture began in the mid -1930s following the introduction of the common carp at two research farms, while more serious engagements began after 1978 with carp purely for research purposes. Egypt's aquaculture production of 1.5 million tonnes in 2015 is by far the largest of any African country. The aquaculture sector, dominated by semi-intensive pond production of tilapia, makes a significant contribution to income, employment creation and provides food and nutrition security in the country, all of which are national priority areas due to low per capita income levels, rising population, worsening food and nutrition security indicators, and unemployment at low levels.

The first modern semi-intensive commercial farm was built by the Government in 1961. FAO fisheries statistics for 2015 indicate that of the Egyptian total production from all sources 1.2 million tonnes (78%) are from aquaculture. Furthermore, the fisheries trade statistics show a negative balance of trade as Egypt imported in 2015 almost 500 000 tonnes of seafood commodities at the cost of US \$ 768.4 million while exporting only about 32 900 tonnes valued at US \$ 31.7 million causing a drain on hard currencies as well as the prices of seafood commodities in the local markets increased substantially. With a population rapidly increasing reaching 104 million people in 2017, low employment, rising fish prices, increasing imports of seafood commodities and other serious developmental activities, the Government decided to embark on large-scale integrated fin fish and shrimp aquaculture projects which aim at becoming self-sufficient, minimize imports, job creation, reduce seafood prices in the local market and export high value species to earn hard currencies. Two such major projects were recently established: One at Birkat Ghalioun in the Egyptian Nile Delta region along the Mediterranean Sea and the other is along the East Suez Canal zone. The question remains, however, if these two mega projects, when fully implemented, along with other small-scale aquaculture projects across Egypt would actually achieve the developmental objectives these projects promise as well as reduce prices of fish to local consumer.

## 1. Introduction

Aquaculture has been known in Egypt since the beginning of written history; tomb friezes date back to 2500 B.C. and illustrate the harvest of tilapia from ponds. Modern aquaculture began in the mid -1930s following the introduction of the common carp at two research farms, from then until the early 1960s, the carp was kept purely for research purposes. More serious engagements however started in the beginning of 1978 with more developed aquaculture practices after the Egyptian Government initiated publicly managed experimental farms as a way to encourage the private sector to invest in aquaculture. FAO latest published fisheries statistics for 2015 indicate that Egypt's fisheries production show that total production from all sources (marine, freshwater and aquaculture) reached 1.5 million tonnes of which 1.2 million tonnes from aquaculture (78 %) and 336 000 tonnes from capture (marine and inland fisheries) (22%). Furthermore, the fisheries trade statistics show a serious negative balance of trade as Egypt imported in 2015 almost 500 000 tonnes of seafood commodities at the cost of US \$ 768.4 million while exporting only about 32 900 tonnes at valued at US \$ 31.7 million which meant a drain on hard currencies as well as the prices of seafood commodities in the local markets increased substantially (Tables 1-2)

**Table 1.** Egyptian Fisheries and Aquaculture Production 2013-2015 (Tonnes)

Fishery	2013	2014	2015
<b>Capture (Marine &amp; Inland)</b>	348 617	336 345	336 005
<b>Aquaculture (Marine &amp; Inland)</b>	1 097 544	1 137 091 F	1 174 831 F
<b>Total</b>	<b>1 446 161</b> F	<b>1 473 436</b> F	<b>1 510 836</b> F

Source: FAO Fisheries Statistics, 2017. F=FAO Estimate.

Egypt is currently experiencing high population growth of about 2.6 million people a year. The recently published population census indicated that Egypt has a population of 104 million people of

which 96 million live in Egypt and the balance estimated at 8 million Egyptians are spread out around the world mainly in the Arabian Gulf countries (CAPMAS, 2017). As a way to meet the challenges of population growth and meet shortages of fish supplies in the local markets, the Government in the last 2-3 years initiated large scale integrated aquaculture projects. Beside the major objective of making Egypt self-sufficient in fish supplies, the new projects are also to increase fish from local sources especially due to the declining trend in catches from capture marine and inland fisheries, lower prices to the consumers and minimize as much as possible the imports of seafood commodities. The new mega projects are mainly the one established in *Birkat Ghalioun (Ghalioun Pond)* in the Nile Delta region and the other along the East Suez Canal region. Other smaller scale projects are also being established by the private sector all aiming at reducing the animal protein food gap in support of the Government's food security efforts. Other reasons include job creation to prevent immigration of youth, earning hard currencies through exports of cultured high value species and reducing to the minimum the over 500 000 tonnes of imported seafood commodities a year. The most commonly imported species are mackerel, tuna and herring beside other seafood delicacies (CAPMAS, 2017; IDSC, 2017).

The question remains however, if the new large-scale aquaculture projects will eventually help bring Egypt self-sufficiency in fish production and/or at least lower the current rising fish prices for the local consumers as well as achieve the aims of the Egyptian Government in implementing these and other related projects and its developmental objectives in this endeavor.

## 2. Brief Summary Of Aquaculture In Egypt

Modern aquaculture began in the mid -1930s following the introduction of the common carp at two research farms, from then until the early 1960s, the carp was kept purely for research purposes. The first modern semi-intensive commercial farm was built by the Government in 1961. This farm had a total area of 120 hectares of earthen ponds growing

**Table 2.** Egypt Imports, Exports & Values of Seafood Commodities (2013-2015).

SEAFOOD TRADE	2013		2014		2015	
	Quantity (Tonnes)	Value (US\$'1000)	Quantity (Tonnes)	Value (US\$'1000)	Quantity (Tonnes)	Value (US\$'1000)
<b>Total Imports</b>	288 360	600 332	585 410	752 457	495 775	768 367
<b>Total Exports</b>	21 427F	25 855	28 775	35 160	32 851	31 734
<b>Deficit in Trade Balance</b>	<b>266 993</b>	<b>574 477</b>	<b>556 635</b>	<b>717 297</b>	<b>462 924</b>	<b>736 633</b>

Source: FAO Fisheries Statistics, 2017.

Nile Tilapia (*Oreochromis niloticus*), Carp species (*Cyprinidae spp.*), North African Catfish (*Clarias gariepinus*) and Grey mullet (*Mugil cephalus*). Further in 1978 the Egyptian Government publicly managed experimental farms in *Zawia*, *Barsiqu* and *Manzala*. These farms were meant to encourage the private sector to invest in aquaculture. Subsequently the government constructed and operated three hatcheries in order to supply fish fry and fingerlings to the growing sector. Currently there are some 600 hatcheries in operation. Also, the government encouraged aquaculture by providing about 140 000 *feddans* (one *feddan* = 4,200 m.sq.) of land, generally close to the lakes, for development of aquaculture. This land was portioned out to support the aquaculture sector (El-Sayed, 2015).

In the late 1970s an aquaculture development plan was proposed to boost the development of the sector. By the end of the plan in the mid-1980s, annual aquaculture production had jumped from a mere 17 000 tonnes to 45 000 tonnes. During this period the Government built four large hatcheries, six fish farms and five fry collection stations. Extensive promotion of aquaculture and easy access to land led to a rapid expansion of the private sector's involvement in aquaculture (Feidi, 2016). This period also witnessed the introduction of new aquaculture systems. By 1984 the first trials of tilapia cage culture in the Nile took place and the farming of common carp in rice paddy fields was undertaken as part of Government extension programs (El-Sayed, 2015). FAO Egypt's fisheries production statistics show that in that year the total fish production from all sources reached 139 975 tonnes of which 19 000 tonnes, or 13.5%, from aquaculture. In the following years aquaculture production increased. In 1990 production increased

further to reach 19.8 % of total production. In 2000 aquaculture continued to grow to 37.3% jumping highly in 2010 to 70.9% and in 2015 to 78% (Tables 1-2).

Until the mid-1980s, aquaculture activities were confined to the Eastern and Northern Delta Regions. All production derived from either semi-extensive or semi-intensive pond systems using fresh and low salinity brackish water. Traditional, privately-owned aquaculture, producing mostly tilapia and mullet, operated using large shallow ponds of up to 25 hectares. Production per unit area was low (250–400 kilograms/hectare). This type of production depends mainly on enhanced natural productivity through the addition of natural fertilizers (manure) and limited use of artificial feeds (usually rice bran) (El-Sayed, 2015).

According to the General Egyptian Authority for Fish Research and Development (GAFRD) there are eleven aquaculture cooperatives with about 1 669 members. Cooperatives provide a variety of services to their members. These services are in the form of technical advice, or offering credits for farm operations or representing the interests of the cooperative members in dealings with third parties (GAFRD, 2013&2015).

Most aquaculture activities are generally located in the Northern Nile Delta Region, with fish farms usually found clustered in the areas surrounding the four Delta Lakes (*Maruit*, *Edko*, *Boruls* and *Manzala*). Fish hatcheries are also generally located in the vicinity of the fish farms except for five large Government hatcheries scattered along the course of the Nile in Upper Egypt (El-Sayed, 2015). The distribution of aquaculture units is shown as blue circles in Figure 1.

Most of the aquaculture production is obtained from semi-intensive culture technology practiced in

brackish and fresh waters lakes and also in cage culture in fresh water and from rice-fish culture. The contribution of intensive fish farms to production is low. In comparison with their freshwater counterparts, aquaculture of marine species is still in an early stage of development.



**Figure 1.** Map of Egypt Showing Possible Aquaculture Sites (Google Maps, Egypt 2010)

Tilapia is the dominant species. It accounts for more than half of all fish produced through aquaculture. Tilapia is followed in importance by mullets and together these two species contributed 85.1 percent of total aquaculture production. Other important species, or species groups, include carps, mainly common carp and grass carp, and catfishes, *Clarias spp* (El-Sayed, 2015).



**Figure 2.** Farmed Tilapia in Egypt (Photo Credit: WorldFish Center, Abassa, Egypt)

The European sea bass (*Dicentrarchus labrax*) and Gilthead sea bream (*Sparus aurata*) have been

the principal species used in marine aquaculture starting in the 1990s. The production of these two species peaked at 18 900 tonnes in 2000. Since then production has declined substantially. However, production recovered in 2009 to reach 10 700 tonnes. In 2008 a remarkable development occurred as the culture of Meagre (*Argyrosomus regius*), took off and reached 2 000 tonnes. With the exception of *Penaeus* shrimp, crustaceans are not cultured in Egypt. Farming of *Penaeus* shrimp was started in the new millennium but the production has been unstable. It reached 3 300 tonnes in 2005, but declined dramatically to 131 tonnes in 2008 increasing to 13 000 tonnes in 2014 (El-Sayed, 2015).

Egypt is the seventh largest aquaculture producer in the world by quantity and the largest in Africa, accounting for 73.8 percent of aquaculture in Africa by volume and for 64.2 percent by value. It employs over 200 000 workers supporting at least one million families. Aquaculture landings helped raise the per capita consumption from 8.5 kg to almost the FAO international average of about 20 kg 2014. Egypt produced 13.8 percent of the world's cultured tilapias.



**Figure 3.** Farmed Shrimp in East Suez Canal Project 2016. (Photos Credit: Al-Ahram Daily, Egypt)

In addition, Egypt is the world's top producer of cultured mullets. The recent development of Meagre culture in Egypt has meant that the global output of cultured Meagre increased substantially (El-Sayed, 2015). Local research institutions and the WorldFish Center, with its regional office in *Abbassa*, near Cairo, are helping improve productivity, increase employment and intensify production from farms and expand into new ones



(Macfadyen et.al., 2011; El-Sayed, 2015; Feidi, 2017b).

### 3. The New Large-Scale Aquaculture Projects

In order to boost the supply of fish to the Egyptian consumers and support the Government's policies in achieving self-sufficiency in seafood and other developmental activities, the Government decided to implement large scale, integrated aquaculture projects to achieve its objectives. In the last 2-3 years, two such mega aquaculture projects were initiated: One such project was implemented along the newly expanded Suez Canal zone, near the Gulf of Suez, and the other is at *Birkat Ghalioun* in the Government of *Kafr El-Sheikh* in the Egyptian Delta bordering the Mediterranean Sea described to be the largest in the Middle East. Below is a brief description of both projects. It is to be noted however, that prior to the new developments the Government has identified 71 sites covering an area of 63 400 ha around the country suitable for aquaculture and offered them for interested investors. The new developments are intended to bring aquaculture to new heights as a way to boost the economy by employing local resources, create job opportunities and increase animal proteins at affordable prices for the general public.

#### 3.1. The *Birkat Ghalioun* Project

In July 2015 a contract of partnership was signed between the "National Company for Fishery and Aquaculture" (NCFA) and the "Chinese Corporation Guangdong Evergreen Group Company" in Zhanjiang aquatic industry of China to implement a fully integrated fish and shrimp farming project which includes a fisheries complex in the town of *Birkat Ghalioun* (*Ghalioun* Pond) in *Kafr El-Sheikh* Governorate in the Egyptian Nile Delta region using Chinese expertise and Egyptian funding and local labor force. The actual works to implement the project on the ground was contracted to the "National Company for General Contracting and Supplies" and several other local support companies. "Evergreen" is responsible to provide the whole plan, design, equipment supply and installation, training to transfer technologies and provide the operating instructions for the project.



**Figure 4.** Construction Works at Birkat Ghalioun Project. (Photo Credit: Al-Ahram Daily, Egypt)

The *Birkat Ghalioun* project, (described as the "Coast of Hope") is a low land area submerged in water and surrounded by a number of poor villages. The area seemed suitable for the development of a large-scale integrated aquaculture project using marine and fresh water sources needed for culturing various species of fish and shrimp employing the most possible high international standards of food safety and quality standards. Marine waters will be drawn from the sea by a lifting station using 12 large pumps and the fresh water is drawn from local sources by 5 large pumps, to be both used as required.

On 17 November 2017, Egypt inaugurated the complex which included an integrated fish farm on an area of 4 000 feddans divided into integrated service areas that make the project self-sufficient and fully independent. The project is expected to be implemented in three consecutive phases ending with an overall area of 21 000 feddans. The number of 1 359 ponds were allocated for fish and shrimp ponds and cages, a hatchery and research facilities, an industrial area of 55 acres comprising of a processing plant, fish processing and packaging of fish with a daily capacity of 100 tonnes per day, a fish meal plant with an annual capacity of 180 thousand tonnes, an ice plant to produce ice with a capacity of 60 tonnes of crushed ice per day and 1 200 ice blocks per day and other logistical and services to the project. Also there are research facilities and laboratories as well as training facilities for the Egyptian labor force to master the latest efforts and techniques in aquaculture. Logistical facilities are also available such as a

power plant to provide electricity for the entire project as well as a back-up unit for the second phase of the project. A fish meal plant is also built to provide feed for the fish and shrimp. A fish processing plant is also provided to produce various value added products of fish and shrimp. A Styrofoam factory to produce boxes for the marketing fish and shrimp locally and for export is also available. Also facilities include one central laboratory, a bags factory, a wastewater treatment plant, and feeding machines and aerators, and two 17-meter workboats. A Summary of the Project's facilities, components and capacities is available in Table 3 below (Al-Ahram, 2017).

The first phase of the project is completed utilizing 1 359 ponds for which 466 ponds were utilized to fish rearing and fattening with a production capacity of about 3 000 tonnes/ year. There are also 83 freshwater ponds for tilapia and mullet in an area of 500 feddans. Also there are 655 shrimp cages to produce an estimated 2 000

tonnes/year intended to supply the local market and for export.

The project also includes an incubator for production of fry to supply the various ponds producing around 20 million fry and 547 tanks for the broodstock. Also a marine shrimp hatchery to produce 2 billion shrimp larvae is built.



**Figure 5.** Construction Works at Birkat Ghalioun Project. (Photo Credit: Al-Ahram Daily, Egypt)

**Table 3.** Components and Capacities of *Birkat Ghalioun* Aquaculture Complex

Project Components	Allocations/Capacities	Comments
Total allocated area	4,000 <i>feddans</i> to be expanded to 21 000 <i>feddans</i>	1 <i>feddan</i> = 4 200m <sup>2</sup>
Water from the sea	50 000 m <sup>3</sup> /h.	12 giant suction pumps
Water lift station	20 000 m <sup>3</sup> /h.	5 huge suction pumps
Sewage plant to drain water	70 000 m <sup>3</sup> /h	15 pumps
Fish & Shrimp ponds Marine Fish Cages	1359 total ponds 100 cages each 20 meters in diameter producing 25 t. each /cycle; placed at 7 m. deep in addition to 7-8 m. below.	466 For rearing and fattening to produce 3 000 tonnes/year; 83 For fresh water tilapia & mullet; 655 For shrimp to produce around 2 000 tonnes/year;
Fry & Incubation basins	155 ponds	17 <i>feddans</i> for marine hatchery consisting of 546 tanks for the broodstock to produce 20 Million marine fish fry and 2 Billion shrimp larvae/year.
Fish & Shrimp meal Plant 55 Feddans	120 000 tonnes for fish and 60 000 tonnes/year for shrimp	
Electricity Plant	80 MW and two generators	Also backup unit for the Phase 2.
Fish & Shrimp Processing plant in 20 000 m <sup>2</sup>	Production of 100 tonnes /day	For value added products: Fresh, frozen, fillets, peeled, half or medium cooked.
Styrofoam Plant	Producing 900-1000 kg/day.	For packing to local marketing or export.
Ice Plant	40 tonnes of crushed ice & 20 tonnes of ice blocks.	
Logistical support facilities	Research laboratories, training,	

Source: Al-Ahram, 2017.

### 3.2.The East Suez Canal Zone Project

Earlier, on 28 December 2016, Egypt inaugurated the first phase of what is described to be a major fish farming project along the Suez Canal near the Gulf of Suez for which 7,500 *feddans* (*feddan*= 10,000m. sq.) were allocated for the project. The first phase consists of 1,029 sedimentation basins east of the Suez Canal costing up to EGP 413 million (equivalent to about US \$ 23 million) from a total target of 4 000 basins throughout the various stages of the project. The production results of the first phase indicated that in January 2017 the first crop of farmed shrimp and breams were locally marketed in the nearby Governorates of Suez, Ismailia and Port Said at less prices than the regular market prices.

One of the intentions of the Egyptian Government for the Suez Canal Authority after

doubling the Canal's waterways is to initiate new approaches to diversify economic activities making use of its infrastructure besides being a major passage for international shipping, trading and to transform the Authority into a larger economic entity based on multiple sources of activities. The first of the projects that the Suez Canal Authority started out is the fish farming project. One of the projects is to make use of the sedimentation basins is the project to culture fish and shrimps. The fish farming project along with the other projects are aimed at creating more job opportunities for young people who consists of a high percentage in the Egyptian population.

Regarding the main components of the project, it is reported that the project will eventually consist of 10 key elements which will include the establishment of the 4 000 sedimentation basins as fish farms supplied with fish fry from locally established hatcheries with an annual supply

capacity of 160 million. In addition supply of estimated 500 million shrimp's larvae is also planned. A feed plant is also planned to provide a two-stage production of 150 000 tonnes/year as well as units to include veterinary and laboratory analysis and research activities. Also a processing plant for fish sorting; packaging and value added production, as well as facilities for training workers, stores for equipment, residential units and accommodation and other related facilities.

It is estimated that production per acre (the pond area is about one acre: 1 acre to hectare 0.4047) is about 5 tonnes of fish. The Bream fingerlings were imported from Greece, Italy and from the domestic market. In the future it is expected to provide locally all the basic infrastructure requirements for fish farming of integrated projects such as a feed mill, processing and marketing of fish locally and for export through a subsidiary company to be established by the Suez Canal Authority.

The new project in the East Suez Canal region as well as other significant projects underway is expected to raise the percentage of aquaculture in Egyptian fish landing to even higher percentages especially at a time when capture fish production from marine and inland sources are at a decline in recent years. Also in the next phase of development mullet will be cultured in the waterways of the project at prices affordable to most consumers.

It is noted the time plan for the project is divided into three main phases: the first phase ended in November 2015 and lasted 20 months, the second phase ended November 2016, and the third phase is expected to be completed by April 2018 (Al-Ahram, 2016-2017).

#### 4.Egypt's Aquaculture Long Term Development Objectives

The fisheries authorities in Egypt claim that these new mega aquaculture projects are to be considered a locomotive for increasing fish resources. Other smaller scale projects are already producing farmed fish and more are expected to be implemented as more entrepreneurs invest in such projects mainly aiming to achieve lucrative businesses and an overall intention of providing and achieving self-sufficiency in fish supplies and

possibly export high value species mainly to European markets and possibly narrow the gap between imports and exports. Egypt in 2015 produced 1.5 million tonnes of fish, the bulk of which comes from fish farming and this production is expected to increase in the next few years. The projects when fully implemented are expected to give promising opportunities after achieving self-sufficiency for the local market and possibly start exporting surplus quantities of the high value species of fish such as Sea bream, Sea bass and Shrimp. Also the production of the popular and cheaper varieties of fish like Tilapia and Mullet can be increased to make them more accessible to the local consumers. The projects also promise reducing the animal protein food gap in support of the government's food security efforts as Egypt is currently facing high population growth. Other reasons for these large aquaculture projects are said to include job creation as a way to combat Egyptian youth from emigrating, earning hard currencies, and reducing the annual imported seafood commodities.



**Figure 6.** Harvesting Tilapia from Birkat Ghalioun Project 2017 (Photo Credit: Al-Ahram Daily)

#### 5.Requirements Needed For Achieving Aquaculture Development

In spite of the new milestones in the growth of fish landings from aquaculture in Egypt, demand for fish is expected to continue to increase not only due to population growth but also due to increase in levels of the price gap of fish and the alternative animal proteins especially from the cheaper species such as Tilapia. Such increased industry sustainability and labor demand require improving profitability through several factors in order to



bring aquaculture in Egypt to much higher standards than what the general situation really is in spite of the high quality and standards promised by the two large-scale integrated projects summarized above.

The aquaculture sector in the short, medium and long-term development plans would require tackling of the following factors:

- Water quality can be low when using it after it is drained from agricultural. Also its availability is sometimes limited during some times of the year due to agriculture requirements. This situation requires the revision of the legislation that governs using drainage water from agriculture to aquaculture needs. In this connection an official in the Ministry of Agriculture recently noted that the Ministry is close in finalizing the amendment of Act No. 124 of 1983 on fishing, aquaculture and fish farms to cope with the current developments in aquaculture a matter which was of high concern to fish farmers (GAFRD, 2017). This Act is the main body of legislation regulating fisheries, fishing, aquatic life and aquaculture. The act contains a number of articles related to fisheries and the aquaculture industry. This law requires licensing of aquaculture activities by GAFRD the agency responsible for the administration and enforcement of the Act. This also implies to the need to expand the areas allocated for aquaculture and give longer periods for land leases to encourage local investors of longer periods to ensure stability for the project;
- With the new Government initiatives to expand and encourage small and medium investment projects, credit with low interest rates are needed to provide capital and finance from the banking sector and to ease the collateral requirements demanded by banks and other financial institutions;
- Any new and or expanded aquaculture projects would require obtaining high quality feed, power and fuel at lower costs as well as better quality fish fry and shrimp larvae as well as high level of training of men and women

workers in this field especially achieving the Best Aquaculture Practices (BAP);

- While the environmental conditions in Egypt are generally favorable for fish production, the colder winter months from January through April place constraints on the fish farming sub-sector due to the lack of cold tolerance of fish and a growth period that is limited to around 8 months;
- There is an over concentration on two major species: Tilapia and Mullet. It is well know that Tilapia in general is easy to culture and can grow much faster in various environments than many other fish species and is sold at cheaper prices. This means that it is a fish that can help eradicate poverty alleviation by increasing its production. Currently there is a commercial breeding program in Egypt started in a private farm and the main emphasis enhancing and improving fish growth, production, and marketing value. In addition to reaching a superior breed of Tilapia using best methodologies, the latest international experimentation on farming other finfish species has proved very successful. Egyptian environment is suitable for farming some new species beside the indigenous ones. For example, Cobia (*Rachycentron canadum*) and Barramundi (Asian Sea Bass) (*Lates calcarifer*) may be added to mariculture farming especially that both new large-scale farms are bordered by marine waters.

Finally, aquaculture may take several forms employing different systems in addition to what Egyptian aquaculture has been accustomed to employ for decades, provided that the various obstacles are somewhat eased in time as progress is made into increasing numbers of aquaculture projects. Some of these forms may be practiced instantly while others will require years of research and experimentation. These forms may include aquaponics, mixing fish with agriculture produce, which is already marginally practiced in Egypt, and also the recirculating aquaculture systems (RAS) for fish production where water exchange is limited. The main benefit of RAS is the ability to reduce the need for fresh, clean water while still

maintaining a healthy environment for fish. To be operated economically commercial RAS must have high fish stocking densities, and many researchers are currently conducting studies to determine if RAS is a viable form of intensive aquaculture. Also capture-based aquaculture whereby “seeds” are collected from the wild to be bred using best aquaculture practices. Finally, some countries already practice fish-fattening farms by which stocks of small size finfish, especially the high value tuna species, are collected from the wild and fed in a coastline cage farm to huge sizes for export to lucrative tuna markets especially Japan.

## References

- Al-Ahram Daily Newspaper; *Birkat Ghalioun* Aquaculture Project; 17, 19 & 24 November 2017; Cairo, Egypt; <http://www.ahram.org.eg/NewsQ/624473.aspx>. & <http://www.ahram.org.eg/NewsQ/623532.aspx>.
- Al-Ahram Daily Newspaper; East Suez Canal Aquaculture Project; 11/ September 2016 & 9 January 2017; Cairo, Egypt. <http://www.ahram.org.eg/NewsQ/623065.aspx>
- Central Agency for Public Mobilization, Statistics (CAPMAS), 2017. Egypt in Figures. <http://www.capmas.gov.eg/>
- Egypt Council of Ministers, Information and Decision Support Center (IDSC); December 2017; Video: <https://youtu.be/rIFROjMvEx0>
- FAO - Fisheries and Aquaculture Information and Statistics Branch - 14/07/2017; Rome, Italy. <http://www.fao.org/>.
- FAO GLOBEFISH Highlights; *Tilapia in Egypt: Towards new Horizons*; Rome, Italy, 2014; <http://www.fao.org/in-action/globefish/market-assets/en/>.
- Abdel-Fattah M. El-Sayed, 2015. *Regional review on status and trends in aquaculture development in the Near East and North Africa – 2015*, by. FAO Fisheries and Aquaculture Circular No. 1135/6. Rome, Italy.
- General Authority for Fisheries Resource Development (GAFRD), 2013-2015. Aquaculture projects and related activities. <http://www.gafrd.org/>.
- Feidi, I.: *Egypt: A New Milestone in Aquaculture Growth*; INFOSAMAK International, No.1 2017a; Casablanca, Morocco.
- Feidi, I: *Expansion of aquaculture projects to boost seafood production: Arab World Agribusiness Magazine* Vol.23/ No.6, 2016; Manama, Bahrain.
- Feidi, I. *Opportunities to Increase Seafood Supplies to Arab Fish Markets*; Arab World Agribusiness Magazine, Vol. 33/No. 8, 2017b; Manama, Bahrain.
- Feidi, I. *The Market for Seafood in the Area of Greater Cairo, Egypt*; INFOSAMAK; Casablanca, Morocco; April 2004.
- Macfadyen, G., Nasr-Allah, A.M., Abdel Reheem Kenawy,D., Mohamed Ahmed, M.F.,Hebicha,H., Diab, A., Mohamed Hussein, S., Abouzied, R.M. and El Naggar, G. 2011.

*Value Chain Analysis of Egyptian Aquaculture.*  
Project Report 2011- 54. The WorldFish Center.  
Penang, Malaysia. 84 pp.

Macfadyen, G., Nasr-Allah, A., and Dickson, M.  
2012. *The Market for Egyptian Farmed Fish.*  
WorldFish Center, Egypt. X pp.

Megahed, Mohamed E.; *Applied Commercial  
Breeding Program for Nile Tilapia*; National  
Institute of Oceanography and Fisheries, Gulfs  
of Suez & Aqaba's Branch; Egypt; Global  
Aquaculture Alliance (GAA) website, Monday,  
30 October 2017.