Development and outlook of Egyptian aquaculture
(historic information – aquaculture and fishery – features of aquaculture - mode of development - challenges - outlook)

Abdel Rahman El Gamal, PhD
Contents

- Fishery resources in Egypt
- Features of Egyptian aquaculture
- Fish consumption, trade and quality
- Issues of concern
- Egyptian aquaculture outlook
Fishery resources in Egypt
Fishery resources in Egypt

Mediterranean & Red Seas, River Nile & lakes are the main sources for capture fisheries

Total fish production from all resources reached 1,518,943 tons in 2015

Aquaculture contribution represents 77.3% of total fish production in 2015

Egyptian aquaculture ranks 7th globally in 2015

About 60% of African aquaculture is produced in Egypt
Aquaculture development
World Bank Mission (1978): findings and recommendations

Potential acreage for aquaculture: 23,400 feddan (9,830 ha).

Potential production from aquaculture 35,000 tons

Average production: 1.5 ton/feddan (3.5 ton/ha)

- Tilapia 50%
- Mullet 30%
- Carps 20%

The total aquaculture production reached about 33 folds of estimated production

However:
Average production from earthen ponds is almost as previously estimated
Species composition in the present is close to what was estimated
Aquaculture development

Building upon the World Bank mission, it became obvious there was a good aquaculture opportunity in Egypt. The practice started with the use of traditional practices whereas inputs and so outputs were low. No use of Nile waters, no use of agricultural land. Capacity building and international experience played a major role in the development. Rapid then remarkable development in aquaculture took place in mid 1990s. Development has been credited to the all-male tilapia as well as to the commercial feed. Of course the well-trained personnel were behind all that.
Features of Egyptian aquaculture
Contribution of aquaculture and fishery in total production (2002-2015)

> 50%

> a million ton

Aquaculture
Fishery
Tilapia in Egyptian aquaculture

Year:
- 1985
- 1997
- 2000
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015

Categories:
- Others
- Carps
- Mullet
- Tilapia
## Features of Egyptian aquaculture (narrow production basket)

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<td>61.9</td>
<td>768752</td>
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<td>759601</td>
<td>66.8</td>
<td>875513</td>
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<td>Mullet</td>
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<td>1017736</td>
<td>100</td>
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<td>100</td>
<td>1174831</td>
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For decades, Egypt ranked second in regard to global tilapia production (after China); in 2013, 2014 & 2015 Indonesia took over and hence Egypt is the 3rd

**Others** include marine finfish, marine shrimp, African catfish, and eels
Breakdown of *others* in 2012 – 2014 & 2015 (52268 - 59016 & 47533 tons)

- **2012**
  - Bass & bream
  - African catfish
  - Meagre
  - Others

- **2014**
  - Bass & bream
  - African catfish
  - Meagre
  - Shrimp
  - Others

- **2015**
  - Bass & bream
  - African catfish
  - Meagre
  - Shrimp
  - Others

Shrimp is hardly seen (only 12 tons)
Status and outlook of shrimp culture

Shrimp farming has a short history
Several marine shrimp species have been tried (Green tiger shrimp- Indian white shrimp and Whiteleg shrimp)
Emerging farming problems are related to water quality and biosecurity
Currently, farming technology is being refined and the outlook is promising
The contribution of tilapia in Egyptian fish production fluctuates.
Suggested causes: production economics – emerging bacterial disease.
Tilapia is a limiting species due to its intolerance to cold – Because of that:

- Growing season starts when temperature warms up (April)
- Peak of harvesting (October – December/January)
- Farms which have warm ground water enjoy flexible management systems and all-year production if justified
- Greenhouses (hatcheries): Starting activities during winter months and provide tilapia fry in April when outdoor temperature warms up
- Open tilapia hatchery – in hapas- operates during late spring and ends by end fall
Fish farming and tilapia

Tilapia (harvesting)

Over-wintering of tilapia

All-year round tilapia farming (well water)
### Total fish production “ton” & aquaculture “%” in selected years

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<td>Aquaculture (% /total)</td>
<td>444867 (50.78)</td>
<td>539747 (60.69)</td>
<td>635517 (63.04)</td>
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<td>Total (ton)</td>
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<td>889300</td>
<td>1008008</td>
<td>1304794</td>
<td>1362174</td>
<td>1371975</td>
<td>1481882</td>
<td>1518943</td>
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</tbody>
</table>

**Source:** General Authority for Fish Resources Development, Yearbook statistics
Production economics is the key factor in determining the mode of production and so the degree of development.

Since mid-1990s, aquaculture witnesses periods of sharp to slight increase to almost stagnation. **BUT** Never decreased till now.
Earthen ponds are the main aquaculture producer: 982,250 tons; 83.6% of total production in 2015

Any improvement in pond productivity will be significantly felt – **Highlighted in the national strategy**

Total acreage of earthen ponds amounted 310,388 feddans (130,365 hectares) in 2015

About 96% of acreage belongs to private sector

Almost all suitable land for aquaculture has been taken out – limited horizontal expansion

Owned land represents 18% of the total area; the remaining areas are either leased or utilized temporarily for aquaculture

Productivity vary significantly

**Earthen ponds**: Will remain the main production system (for economic reasons)
Other aquaculture types

- Intensive farms
- Cages
- Integrated rice-fish & others
Nile cage aquaculture
Banning/Coming back/Banning

Damietta/Rosetta Branches (banned – lifted)

In sensitive water such as the Nile, unless cage farming practices meet the environmental and public health standards & navigation requirements, its sustainability is questionable

In Rayaan - Fayoum

Silver carp was promoted as friendly fish - However, tilapia remains the species of interest

Lifting cages in Rosetta – July/2015
Emerging systems (desert aquaculture)

**Advantages:**
- All-year production
- A promising system for export
- Usually integrated with other plants and/or livestock

**Limitation:**
- Sustainability of underground water
- How construction costs

Fresh or Marine
The only source for mullet farming (no commercial mullet hatchery – some trials)

Same is true for European seabass and gilthead seabream (few millions are hatchery produced)


About 98% of collected fry belong to mullets; negligible numbers are seabass, seabream and meagre.
Where collected fry goes?

Aquaculture
Stocking of natural waters

There is always a debate between fishermen and fish farmers about fry collection.

Fishermen claim the harm on capture fishery due to the collection of wild fry.

Fish farmers claim that higher survival and biomass are achieved in aquaculture facilities.

The value of stocking programs requires validation otherwise biased opinion may develop.
Since 1990, the use of herbicides in the control of aquatic plants in the River Nile and irrigation canals has been banned. Use of grass carp, *Ctenopharyngodon idella* has been introduced as a biological control agent.

The Channel Maintenance Research Institute (CMRI) of the Ministry of Water Resources and Irrigation is in charge of the program (seed production and release)- Grass carp seeds are produced in collaboration with governmental hatcheries.

Two components are needed to supplement this program: Impact assessment Creating awareness and introduce catch and release concept among fishermen
Tilapia hatcheries in the present are primarily private.
Realistically, actual tilapia fingerlings should exceed by far the reported 333 million in 2014 and 137.5 million in 2015.

Fingerlings of carps are only produced in governmental hatcheries with a total of 213 million in 2014 and 207 million in 2015 (common, silver and grass carp).

Most of common carp fingerlings are produced for rice-fish culture.
About 47 million of grass carp fingerlings are produced for the biological control of aquatic plants (in 2014)
Few marine hatcheries are in limited operations (13 million in 2014 and 30 million in 2015) of seabream, seabass and shrimp; a million of mullet fry was produced in 2015.
Fish feed industry

A growing industry; (about 500,000 tons at present) produced by feed mills with different capacities and technologies

Fish feed is more directed towards tilapia

Most of feed ingredients are imported (about 75%)

Some feed mills have got “Good Manufacturing Practices” standards

Active joint venturing with international companies is now in place

Some feed is exported to Arab and African countries

Some specialized feed is imported for marine fish/shrimp
Fish consumption, trade and quality
Fish consumption and trade

The Per capita fish consumption in Egypt is close to, or slightly exceeds the world average (20.5 kg/2012; 19.7 kg/2013; 23.5 kg in 2014 and 20.1 kg in 2015)

The national strategy aimed to maintain the world average from the local production by 2017

Fish import fills the gap between national production and consumption (390,605 t in 2010, 182,222 t in 2011, 335,000 t in 2012, 236,000 t in 2013, 584,000 t in 2014 and 296,000 in 2015). Foreign exchange rate influences fish importation

Only a modest quantity primarily of marine capture fishery is exported (9,489 t in 2011 increasing to 15,810 t in 2012 and then 20,450 t in 2013, peaking to 28,000 in 2014 before declining to 19,700 tons in 2015). Most of the exports are Mediterranean fish

The floatation of the Egyptian pounds came in the favor of the export of tilapia and mullet in 2017
# Fish trade - quantities of fish import & export (ton)

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<td>182222</td>
<td>335000</td>
<td>236000</td>
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<td>296000</td>
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<tr>
<td>Exports</td>
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<td>9489</td>
<td>15810</td>
<td>20450</td>
<td>28000</td>
<td>19700</td>
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<td>Available for consumption</td>
<td>1551011</td>
<td>1534907</td>
<td>1691165</td>
<td>1669951</td>
<td>2037882</td>
<td>1795000</td>
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</tbody>
</table>

Source: General Authority for Fish Resources Development, Yearbook statistics

- Importing cold water fish is required in some markets & needed for smoking.
- Importing species of production shortage is quite normal (e.g. shrimp).
- However, importing tilapia is a real concern.
Wholesale fish marketing

The central fish market “Obor” is located in Cairo. The market receives fish from various sources (capture fishery, aquaculture and imports).

The wholesale fish market in Kafr El Sheikh has been established to serve the fish trade in the governorate especially about 41.9% of total fish in Egypt in produced in Kakr El Sheikh; out of which 539,564 tons from aquaculture which represents 47.5% of total Egyptian aquaculture (2014). From this market, fish is distributed within and outside the governorate based on demands.

Auctioning is the system practiced in the central/wholesale markets whereas a fixed fee is deducted from the sale transaction against the market service.
Retail shops provide fish to consumers directly.
Retail shops vary in size and in fish displayed.
Depending on locations, purchasing power and preferences of consumers, fish demand and supply varies.
In coastal areas, marine fish and shell fish will be displayed more compared to the delta regions whereas tilapia and mullet are more common.
Retail shops are either clustered in bigger markets or could be individually located where the demand exists. Weekly village markets are very important in fish marketing.
Large supermarkets often display fish of different species & in different types of preparations.
On-the road fish sale

It is common to find individuals selling fish along main roads especially close to lakes. Those could be related to fishermen or just independent jobs. Interestingly, many buyers believe more in the freshness of these fishes based on the closeness to the fishery resources.
Quality issues

Quality awareness is steadily developing among producers and consumers over time. The competition among producers led to new marketing initiatives (e.g. out-of-season marketing).

Improving fish quality is more adopted when associated with economic returns such as live fish marketing.

Media plays important role and may – sometime- discourage fish consumption whether based on true information or on rumors.
Fish processing

The main types of fish processing in Egypt are:

**Salting:** this is mainly applied to mullets (*Mugil* sp.) to meet the peak of demands during the eastern. The sources of mullets for salting are either capture fishery or aquaculture. Few processors label their salted mullet in order to enable the display of their products in supermarkets and also in regional markets. On-boat salting is also done on several species of Lake Nasser catch including *Alestes* sp., *Labeo* sp., *Hydrocynus* sp., and *Eutropius niloticus*. Wild caught sardines are also salted.

**Smoking:** smoking is performed on imported frozen fish of cold water species (herring like species). A trial was done on African catfish and common carp but was never commercialized.

**Filleting:** performed mainly on large-size tilapia and Nile perch from Lake Nasser and few of Red Sea species such as grouper. Fish fillets (fresh/frozen) aim to meet market demands as well as to achieve efficient transportation to target markets.
Human resources

- Debatable statistics on the number of people involved in aquaculture and related activities: (Farms – hatcheries – feed mills – transport)
- Some activities are of multiple purposes (feed mills, market, processing)
- About 75,000 people seems a good estimate based on a somehow reliable study

Lack of official figures on human resources involved in aquaculture activities may cause the magnification of the number of people to create social pressure (e.g. banning cages)
Issues of Concerns
## Limitation of natural resources

### Water

Severe competition on water use especially the per capita water consumption is 680 m³/year (1000 m³/year is the water poverty limit).

Agricultural crops enjoy priority over aquaculture in regard to water use.

There is some of unutilized water resources (under-ground, brackish, marine).

### Land

Almost all suitable land for fish culture are being already utilized as fish farms.

Converting the temporarily fish farms into agriculture after salt washing –if happened- would significantly reduce the acreage of fish farms and so fish production.

Desert when used for aquaculture requires much higher investments.
## Legislations on the use of natural resources

### Water

With the exception of freshwater hatcheries, farms are not entitled to use river waters.

Only agricultural drainage water is allowed in fish farms. Ensuring that water should be safe.

Even though the use of brackish water in northern delta is encouraged, roads, power and other utilities are needed.

### Land

The lease term was five years and then ten years. Because most of fish farms are on leased lands, longer lease term encourages the investments as well as benefitting of available credit lines. Recently, the lease term has been extended to 25 years conditioned to good farming practices.

Aquaculture should not be practiced over agricultural land. Hence, once the salt content of the temporarily fish farms is washed up, these farms should turn into agriculture.
Dealing with the limitation of natural resources (water & land)

Adopting any of the following scenarios:

- Intensification of farming practices when economically feasible
- Promoting integration and/or rotation systems
- Introducing new initiatives such as aquaponics
- Focus on means for the utilization of under-utilized water resources especially marine or brackish water
- Piloting off-shore cages before encouraging private investments
Water scarcity and aquaculture:

Intensification trend is widely adopted under the limitation of land/water
Water scarcity and aquaculture: Integration with rice and other crops

Rice-fish culture

A large-size national program supported by the government with a total production of about 15,000 tons of common carp

Common carp fingerlings are provided at no cost

Integration with agriculture

The integration with horticulture is in practice (banana, guava, mango)

Also with vegetables & alfalfa

Reduced chemical fertilization & enhance product quality
Water scarcity and aquaculture: Rotation with strategic crops (wheat & alfalfa)

The rotation between aquaculture and wheat and alfalfa leads to a better use of land (win-win situation)

The practice began in the early 2000s

Still relatively insecure according to the Law 124 in regard to land use

Change in legislations is required to promote this practice further

The outcomes of the conducted studies are positive

Quantifying the size of this practice is still based on field observations
Water scarcity and aquaculture: Use of under-utilized brackish water

Brackish under-ground sources are not adequately utilized –if any-

A promising water source subject to:
   Sustainability of water resources:
      Seems abundant (solid information)
   Availability of key infrastructure (especially roads and power)

Soil structure in the location

Longer lease term with reasonable fees
Aquaponics

Starts at experimental level
Expanding in expensive models at a slow rate
Great chance for dissemination
Greater potential whenever water gets scarce
Aquaponics for family consumption & rural development is expected

Example of tested crops
Screening will be based on production economics
Off-shore cages
Piloting before scaling-up

Egyptian-Italian project
European sea-bass and gilthead are the target species
Piloting takes place in the Mediterranean
Other water bodies such as Red Sea are targeted
Mega Aquaculture Project

Four-phase project covering about 11,000 ha – Kafr El Sheikh

First phase is almost ready (1100 ha)

Main components:
- Fin fish and shrimp ponds
- Fish and shrimp hatcheries
- Feed mill
- Ice-making factory
- Foam factory
- Processing plant for fish and shrimp
- Research and Development Center
Farm economics – High cost of feed

Most feed ingredients are imported and so influenced by the foreign exchange.

Over a 9-year period: Feed prices increased by 284% while fish prices increased by 152%.
How farmers could survive the high cost of feed

- Accepting lower profits compared to before
- Increase the productivity/unit area (conditioned to economics)
- Enhance the utilization of feed
  - Better feed quality/better water stability
  - Reduce feed wastes (quality, feeders)
  - Reliance of natural food for sufficient time before administering commercial feed
  - Attempting to introduce non-feed consuming species such as silver carp (did not work as hoped)
  - Improving tilapia marketing and revenue (live fish marketing)
- Not much to do except waiting for the best which could be a function of others (price increase of red meat; bird flu)
- Attempting to use non-conventional ingredients was not practical due to wrong choices
A growing interest in the farming of some native species (e.g. African catfish and Nile perch).

The availability of Nile perch seed and the low marketability of African catfish represent a major constrain.

Expanding production basket could be partially addressed through processing and added value products.

Hatchery technology has not developed yet

Seed production is now possible; Catfish is not enjoying enough consumer acceptance
Expanding production basket
Promoting marine aquaculture (1)

The production of marine species is far below potential.
The competition among various sectors (e.g. tourism) represents a main obstacle hindering the development of marine aquaculture.

Most marine fish could be marked locally especially some importation takes place (e.g. shrimp).

Export should consider the international competition.

Marine aquaculture along the new Suez Canal is hoped to significantly add to this sector

Whiteleg shrimp L.. Vannamei is the newest comer
Expanding Production basket
Promoting marine aquaculture (2)

Existing facilities are adequate especially hatcheries and feed mills

Well-trained human resources are available

Land-based farms on brackish & marine water is a promising once technically and economically justified

Off-shore cage farming is getting more attention in the present and is now in the piloting phase
Expanding production basket
Attracting species (Eels)

Farming of European eels is practiced in several farms in one region.
Eel farming is stimulated by:
  availability of elvers
  market demand – high market price
However, the current practices are far below commercial level.
Training is a regular component in governmental programs (in-country and overseas)

Private training programs have been organized for different stakeholder categories (farmers, officials, processors)

Training curriculums tried to cope with development mode and challenges of the sector (e.g. feeding)

Training the trainers was found very effective (governmental & academic staff)
Multi Sector Support Programme (MSSP), (1996-2004) was initiated by the Ministry of Agriculture and was funded by the European Commission (EC).

The program was designed to provide soft loans to four agricultural sectors including aquaculture.

Technical assistance was an integral component of the program to ensure successful implementation of credits.

Upon the completion of MSSP, the program has undergone some modifications and merging resulting in ASDP, ARDF and finally ADP program.

However, providing soft developmental loans continue to be the key activity of the emerging programs.

Soft loans are also provided by the Social Fund for Development (SFD)
Laws, decrees and regulations to address:

Water and land use

- Nile water is only permitted to freshwater hatcheries (not fish farms)
- Fish farms are not permitted on agricultural land
- There are current to revisit and change the articles on water/land use in aquaculture

Law of Environment (discharge of effluents)

- According to the Environmental Law no. 4/1994, new aquaculture establishments have to comply with environmental standards (EIA has to be filed and accepted)
Laws, decrees and regulations to address:

Introduction of non-native species
For several decades, no exotic species was allowed
A scientific committee has to decide that

Use of veterinary drugs and chemicals
Some chemicals are banned (e.g. sex reversal hormone and antibiotics)
The use of a chemical in the origin country is a must

Feed manufacturing and additives
Imported feed ingredients/additives should be approved
Different formulas should be registered before manufacturing and use
Fish introduction

**Well-established species** (introduced in 80s)
- Common carp
- Silver carp
- Grass carp (aquaculture & control of aquatic plants)
- Bighead carp

**Most recent introduction** (in 2015)
- Whiteleg shrimp

**For aquaculture (1)**

**For aquaculture (2)**
- Freshwater prawn (experienced marketing difficulty)

**For biological control**
- Mosquito fish for malaria control
- Black carp for bilharzia (research)

**For aquaculture (By mistake)**
- Red swamp crayfish
In 2015, while 59.7% of African aquaculture is produced in Egypt, only 3.9% of fish caught in Africa belongs to Egypt.

The decline of Egyptian share in African aquaculture means higher progress of aquaculture in Africa.

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<td>Egypt: total Africa (%)</td>
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## Egyptian aquaculture
(Global perspective – Top Ten- 2011/2014/2015)

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<th>Country</th>
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</table>
Institutional framework

Key GAFRD Mandates

- Implementation of national policy of fishery sector
- Enforcing fishery regulations
- Licensing aquaculture projects
- Establishing pilot projects especially on new technology
- Supporting national aquaculture projects
- International & regional cooperation
- Fishery statistics year book
- Extension service

Direct cooperation with:
- Aquatic police (Ministry of Interior)
- Ministry of Water Resources & Irrigation
- Aquatic Union (Cooperatives)

Cooperates with:
- Ministry of Environment
- Ministry of Public Health
- Universities & research institutes
- State Governorates
- Others

11 Cooperatives
1566 members
Few cooperatives are adequately active
Aquaculture Research Network

Research institutes are affiliated to different governmental bodies:

Ministry of Higher Education:
- Universities – Departments in related collages (agriculture, science, veterinary medicine) - two faculties of fisheries (Suez & Kafr El Sheikh)
- Academy of Scientific Research & Technology
- National institute of Oceanography and Fisheries
- National Research Center

Ministry of Agriculture and Land Reclamation
- Agricultural Research Center
- Central Laboratory for Aquaculture Research
- Lake Nasser Development Center

International Organization
- World Fish Center
Conclusion
Egyptian Aquaculture outlook (1)

National strategy targeted the production of 1.5 million tons of fish from all resources by 2017 *(Already achieved in 2015)*

No matter how species diversification is required, tilapia will continue to be the leading species

Production economics will remain a key element in the sustainability of aquaculture development

As competition gets stronger, quality of fish products would be be highly considered

Issues such as disease, environmental concerns and product quality are expected to influence the development mode of aquaculture
Various types of integration are expected to spread out
About a million tons of commercial fish feed will be needed by 2017; out of which a part should target marine fish and shrimp
Local market will remain the focus of fish production with some specific exports whenever relative advantage exists (e.g. chilled tilapia fillets, tilapia and mullet export in 2017)
Practicing the farming of bivalve and oyster is expected to launch even for export
Research should be working closely with production systems
Extension service needs more support and should be engaged with producers, researchers and carried out by well-trained staff