COMMODITY RESEARCH

SEAS OF CHANGE

Aquaculture Fact Sheet

Working Document

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Key highlights:

- The supply of fish and shellfish caught from seas and inland waters will not increase. The growing demand for fish and other seafood can only be met with increased production of farmed fish and other aquatic animals.
- With an average growth of 6.6% since 1970 aquaculture (= the farming of fish, shrimps, shellfish, etc) is probably the fastest growing food-producing sector. It now contributes 48.5% of all the seafood consumed directly by people.
- Asia is by far the largest producer of farmed seafood, with the people's Republic of China contributing 62% of the global farmed fish and shellfish.
- Eleven million people are employed in farmed fish production as owner or labourer on fish and shellfish farms. About three times as many are employed in production and supply of inputs or in trade and processing of farmed fish.
- Supportive government policies, skilled and knowledgeable staff and reliable sources of good quality fingerlings and fish feed have shown to be important for the development of a vibrant aquaculture sector.
- In Egypt small- and medium scale fish farms were able to intensify production of fish from ponds by the application of a set of new technologies. The sector was able to meet the growing needs of an increasing Egyptian population, making farmed tilapia one of the cheapest sources of animal protein and widely available.
- In Nigeria thousands of small backyard producers have emerged recently, growing African catfish mainly in small concrete tanks and small ponds. Foreign companies have played an important role at the start of the industry 10-15 years ago with technical advise, intensive modern production methods, mass production of quality fingerlings and supply of good quality fish feed.

1. Main highlights of global farmed fish production, trade and consumption; potential and challenges for the sector

1.1 Production

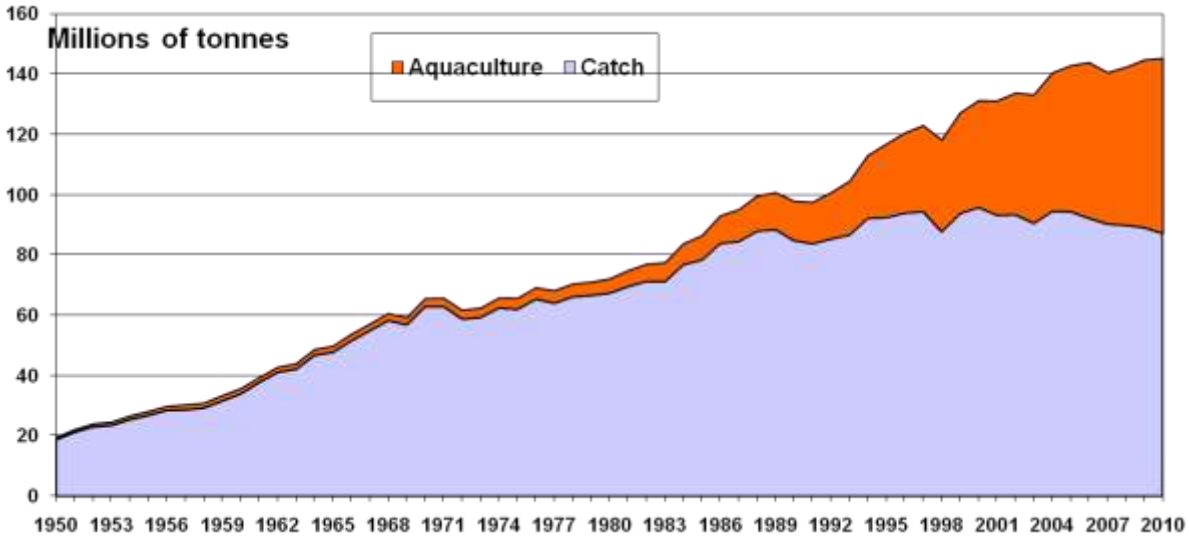
With an average growth of 6.6% since 1970 aquaculture (= the farming of fish, shrimps, shellfish, etc) is probably the fastest growing food-producing sector. Of the 119 million tonnes of fish directly consumed by people in 2009, 48.5% (58 million tonnes) was the result of farming. The lion's share of farmed fish **production** (89%) takes place in the Asia-Pacific region; the People's Republic of China alone is responsible for 62% of the world's total farmed fish production.

Table 1. World fisheries and aquaculture production, million tonnes, 2009

Capture:	88.9
Inland (freshwater)	10.3
Marine	78.6
Aquaculture	55.7
Inland	38.1
Marine	17.9
Total	144.6
For direct human consumption	121.8
For fish meal, fish oil, etc	22.8

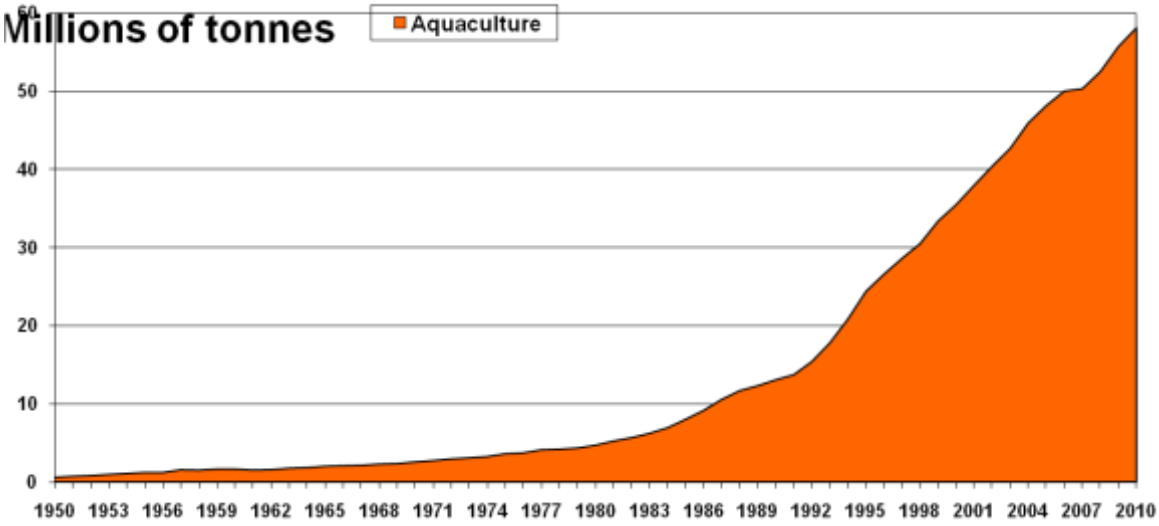
Source: FAO Yearbook of fishery statistics, 2011.

Figure 1. Global production of farmed fish and captured fish.



Source: A. Lem / FAO, 2011

Figure 2. World aquaculture production, 1950 – 2010.



Source: A. Lem / FAO, 2011

In the last two decades, aquaculture has recorded rapid growth among the food-producing sectors and has developed into a globally robust and vital industry. This development has come about largely because of the development and application of breeding, feed and farm management techniques by national and international research bodies and the private sector.

1.2 International trade

The share of fish production (live weight equivalent) entering international trade as various food and animal feed products increased from 25 percent in 1976 to 38.5 percent in 2009, with a total value of US $ 100 Billion.

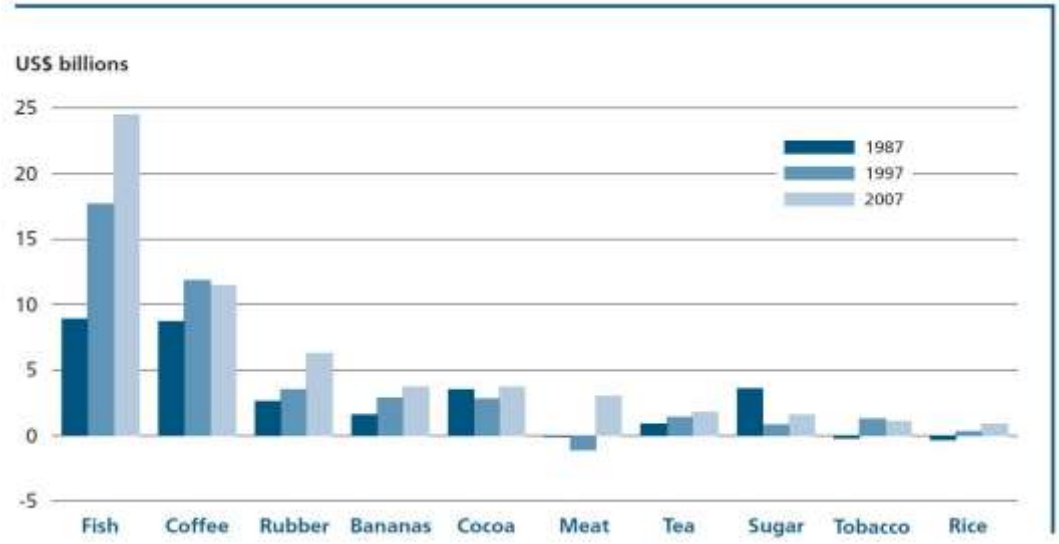
Farmed fish enters the general fish trade chain. In general it is difficult to determine the extent of aquaculture products in this trade because the classification used internationally to record trade statistics for fish does not distinguish between products of wild and farmed origin. Hence the difficulty to distinguish amounts and value of farmed fish from the over-all fish trade figures.

The international trade in fish products has grown steadily in the past decades. World imports of fish and fish products reached a new record of US$108 billion in 2008, up 9 percent on the previous year and up 95 percent with respect to 1998. Due to the crisis the value dropped to US $ 99.7 billion in 2009. In 2008, trade in fish and fishery products represented about 10 percent of total agricultural exports (excluding forest products) and 1 percent of world merchandise trade in value terms.

The role of fishery trade varies among countries but is in particular important for many developing nations. In addition to the sector's role in employment, income generation and food security, trade in fish represents a significant source of foreign currency earnings. In 2008, about 50 percent of the fish import value of developed countries originated from developing countries.

Fish has become one the most important exported food commodities of developing countries.

Figure 3. Net exports of selected agricultural commodities by developing countries



Source: State of the World Fisheries and Aquaculture. FAO, 2010.

In terms of value, China, Norway, Thailand, Denmark and Vietnam are the most important fish exporting countries, with the Netherlands at 10th position. Japan, USA, Spain, France and Italy are the world's leading fish importers.

With a share of 28% of the global traded fish product value, the EU is the largest fish importer of the world. This figure excludes intra-EU trade. Owing to stagnating domestic fishery production, developed countries increasingly rely on imports and/or on aquaculture to cover their increasing domestic consumption of fish and fishery products.

Owing to the high perishability of fish and fishery products, in quantity terms (live weight equivalent), 90 percent of trade in fish and fishery products consists of processed products (i.e. excluding live and fresh whole fish). Fish are increasingly traded as frozen food (39 percent of the total quantity in 2008, compared with 28 percent in 1978).

Popular traded species

High-value species such as shrimp, prawns, salmon, tuna, groundfish, flatfish, seabass and seabream are highly traded, in particular as exports to more affluent economies. However, low-value species such as small pelagics are also traded in large quantities in the other direction to feed low-income consumers in developing countries. For example: By value, Africa has been a net fish exporter since 1985, but the continent is a net importer of fish in quantity terms, reflecting the lower unit value of the imports (mainly cheaper species such as mackerel, horse mackerel, sardinella, croaker and herring).

Farmed species imported in international trade:
Products derived from aquaculture are contributing an increasing share of total international trade in fishery commodities, with species such as shrimp, salmon, molluscs, tilapia, catfish (including *Pangasius*), seabass and seabream. Many of the species that have registered the highest export growth rates in the last few years are produced by aquaculture.

1.3 Employment

It is estimated that 11 million people are employed directly on fish, shrimp and shellfish farms, either as owner or as member of the labour force. Over 10 million of these are located in the Asia-Pacific region.

FAO stresses that these figures are indicative and underestimate the real numbers due to incomplete or over-aggregated employment data submitted by many member states.
In general, employment in the fisheries sector has grown faster than the world population, and faster than in traditional agriculture. This is even more the case in aquaculture.
For each person working in the fisheries sector, three others are employed in secondary activities such as production and supply of inputs, processing and trade. This would bring the estimate of the total number of people employed in the aquaculture sector to 44 million.

Aquaculture's growing contribution to employment has been caused simply by the growth of production (in volume and value) and by the expanding worldwide presence of aquaculture products in retail trade and as raw material to the processing sector.

1.4 Consumption

Aquaculture's contribution to global per caput fish production has grown from 0.7 kg in 1970 to 8.4 kg in 2010.
In 2010, there was on average 17.3 kilos of fish per person available. Per caput consumption of fish varies widely among states, with over 100 kg/person/year in the Maldives and less than 2 kg/person/year in Pakistan. (Source: State of World Fisheries and Aquaculture. FAO, 2010; A. Lem/FAO, 2011, FAO Yearbook of Fisheries Statistics, 2011).

1.5 Challenges facing aquaculture producers in developing countries

Supplying a growing world population
If overall fish supply is to keep pace with an expanding world population, and with production from capture fisheries remaining stagnant at best, future growth of fish production and consumption can only come from aquaculture. If the present level of consumption is to be maintained, aquaculture production will have to grow to 66.7 million tonnes/year in 2050.

Governance: an enabling factor or a hindrance
One of the important reasons why aquaculture entrepreneurs flourish in some jurisdictions but not in others is governance. It makes a big difference whether a government takes a supportive stand and provides infrastructure, legislative support, and easy permit application procedures, or does none of these and frustrates producers with unnecessary bureaucratic hurdles and high taxes.

This is not only the case for table fish producers but especially for producers / suppliers of necessary inputs such as feeds and fingerlings.

One common goal that countries have pursued with aquaculture governance is the sustainability of the sector. Sustainability requires environmental neutrality and social acceptability of the industry. It also requires, for the industry as a whole, revenues that, on the one hand, provide compensation for risks associated with aquaculture and, on the other, ensure long-run profitability of aquaculture activities.

The risk of fish diseases, pollution, natural calamities

Although aquaculture is in most places a rather new industry, there is already a record of companies and even whole countries where the sector has seriously suffered from various diseases. IHN, VHSV, ISAV and Koi Herpes Virus are names of highly infectious viral diseases that are the scare of many fish farmers. EUS is a fungal disease that has hit many Asian fish farms. Shrimp farms in Asia and Latin America have suffered from Taura, White spot Syndrome, Yellow Head Syndrome and other shrimp diseases. Where farms are close together, diseases can spread quickly through use of common water sources and discharge of waste water. Techniques to avoid infection such as pathogen-free brood stocks, vaccination, quarantine, strict hygiene and treatments are, or have been, developed.

Fish farms relying on open water sources (and sometimes even when ground water is used) are vulnerable to water polluted by agricultural enterprises, industry and from domestic waste water. Pollution can lead to mortality and/or poor growth of fish. Development of toxic algae blooms in coastal areas and estuaries, probably the result of agricultural and domestic waste, have caused serious damage to fish and shellfish farms, and have affected the health of consumers eating products from affected areas. Healthy-looking fish can accumulate hazardous chemicals such as heavy metals, agricultural pesticides and chemical pollution that can affect the health of consumers. Developed countries attempt to protect their citizens with frequent checks on domestically produced or imported fish, but such monitoring and control is less well developed in many developing countries. When regulations regarding pollution control and product safety exist, there is often much to improve on implementation, control, and enforcement.

Drought, floods, earthquakes, tsunamis and storms have caused heavy damage to fish farms in many areas.

Access to good-quality inputs and markets

In many countries, especially in Sub-Saharan Africa, the lack of good quality inputs (fingerlings, feed) as well as access to markets inhabit the development of aquaculture.

Trained staff

Lack of personnel trained and equipped to deliver advice and information of technology, production management has prevented development of an effective aquaculture extension system.

Competition for suitable sites with other users

In countries with a developed aquaculture sector producers find themselves competing with others for suitable sites. Agriculture, expanding housing areas and industrial sites, and tourism are often also interested to use the sites that would be suitable for aquaculture. Proper land use planning and coastal resource management and their effective implementation can regulate and accommodate the interest of various parties.

Competition for resources with other users

Depending on the location, the available land, freshwater, feed inputs and credit can be limiting for a further development of aquaculture. Agricultural activities can compete for limited freshwater resources and credit, and the demand for livestock feed can limit the available inputs for fish farming.

Sources:

Edwards, P. and Md. Sazaad Hossain (2010) Bangladesh seeks export markets for striped catfish. Global Aquaculture Advocate, May-June 2010, p. 65-66.

FAO (2010) The State of World Fisheries and Aquaculture

Lem, A. / FAO (2011) Status of food security, trade and the economic health of fisheries (presentation at Procida, October 2011)

FAO (2011) Yearbook of Fisheries Statistics

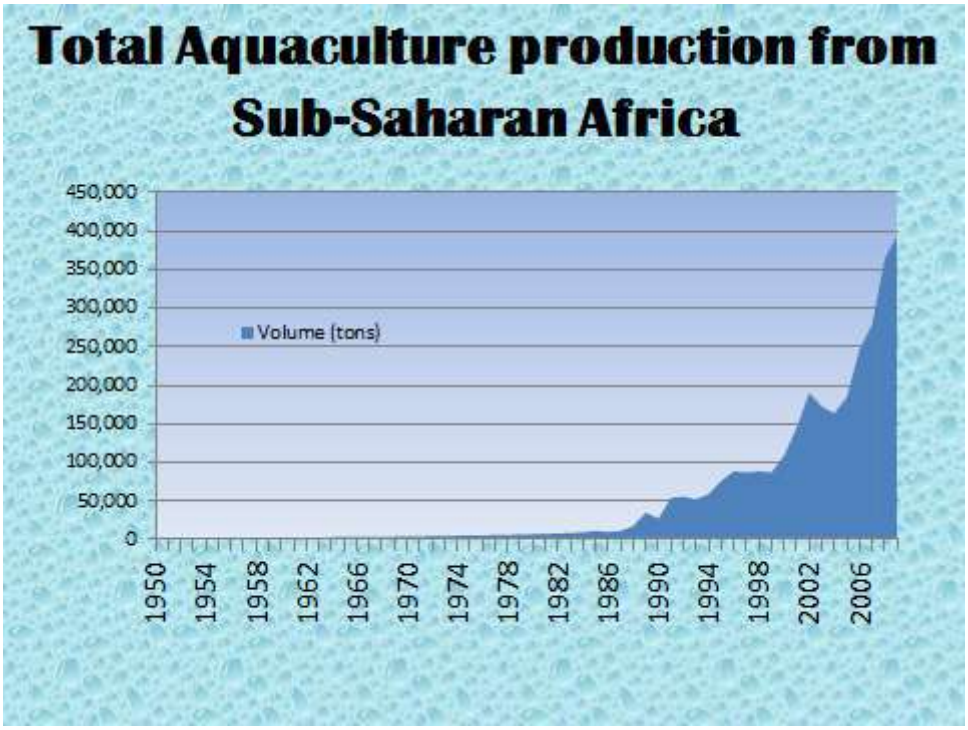
Lam T. Phan, Tam M. Bui, Thuy T.T. Nguyen, Geoff J. Gooley, Brett A. Ingram, Hao V. Nguyen, Phuong T. Nguyen and Sena S. De Silva (2009) Current status of farming practices of striped catfish, Pangasianodon hypophthalmus in the Mekong Delta, Vietnam. Aquaculture 296: 227 - 236

2. Aquaculture production in Sub-Saharan Africa

In the past 50 years hundreds of millions of dollars have been spent for programs to support especially governments of SSA countries to develop aquaculture in rural areas. A significant number of foreign-funded projects and programmes have attempted to tackle bottlenecks such as the lack of fingerlings, feed and trained personnel. Most activities were targeting small-scale rural producers with one or a few small ponds. However, most activities started by such projects and programmes soon came to an end after foreign / international financial and technical support ended. At the end of the millennium the general conclusion was that the attempts to stimulate small-holder or backyard aquaculture development in rural Africa had resulted in thousands of poorly producing or abandoned ponds and dozens of government-owned hatcheries that had very low production or had been closed. Most of the assistance and efforts had not resulted in a vibrant sector nor a significant and wide-spread production of farmed fish, local exceptions left aside.

However, the emergence of private sector-led small and medium scale enterprises applying more intensive production systems, and the establishment of new commercial fish farms (or the expansion of established large commercial fish farms) at the end of the 20th century in Nigeria, Uganda, Madagascar, Zambia and Ghana catalysed aquaculture production in Sub-Saharan Africa in the past decade. Between 1998 and 2009, there has been a five-fold increase in production from 42,587 to more than 350,000 tons. In some cases growing public support and the inflow of foreign capital and expertise stimulated the growth.

Figure 4. Total aquaculture production in sub-Saharan Africa, 1950 - 2009.



Source: FAO Fisheries Statistics (cited in Miller & Leschen, 2011).

The increase of production was due to increasing prices for aquatic products along with the emergence and spread of small and medium aquaculture enterprises, a significant investment in cage culture accompanied by the expansion of larger commercial ventures, some producing high-value commodities for overseas markets.

The production consists for over 95% of freshwater fish species, mainly African catfish (52%) and various species of Tilapia.

As the sector develops and activities in Sub-Saharan Africa intensify, it will face several challenges such as: meeting the growing demand for capital; seed and feeds in terms of quantities and quality; strengthening the base for aquaculture management; increasingly severe competition with other resource (land/water/feed) users; and improving the overall governance of the sector. However, with the stagnation of both marine and inland capture fisheries production, expanding markets and services, growing urbanization, increased opportunities for private sector development etc., the possibilities for increased growth in Sub-Saharan Africa are enormous.

References:

FAO (2011) Regional Review on Status and Trends in Aquaculture Development in Sub-Saharan Africa – 2010. FAO, Rome.

Miller, J. and W. Leschen (2011) Report of 'Regional Seminar on Commercial Aquaculture Development in African Countries Bordering the Atlantic Ocean (ATLAFCO), Libreville, June 8-10, 2011)

2.1 Aquaculture development in Nigeria

Over 50% of the farmed fish in Sub-Saharan Africa is produced in Nigeria. Nigerian production has increased from 30,000 tonnes in 2003 to 150.000 tons in 2010, and is still growing. The growth is a result of confluence of market, social and technical change factors.

There is a **strong demand for fish** in Nigeria, leading to good market opportunities. The Nigerian fish production from capture fisheries cannot supply the demand of fish by the large Nigerian population (now close to 150 million), and annual imports of fish are approx. 700,000 tonnes. The federal Government of Nigeria would like to replace imported fish with locally produced fish. With this objective the Aquaculture and Inland Fisheries Programme(AIFP) was started in 2003. This was followed by the National Programme for Food Security (NPFS).

There is strong **consumer preference for African catfish**. This is a strong, hardy fish that can be kept in very high densities. It can be sold alive and held for days in little water.

Private investments in sound farm management. Realizing the market opportunity entrepreneurs started to convert pond infrastructure used before for extensive tilapia production to catfish production. The lack of managers with experience in running an intensive fish farm led to hiring of experienced managers from Europe. Also joint ventures with European companies were started. Nigerian farm owners and managers participated in training courses and field trips in the Netherlands, UK and Israel. The result was a number of commercial farms doing economically well, and their example attracted attention of others who hoped to replicate the success.

Professional aquaculture associations such as FISON, NAFFA and CAFAN were formed. These associations stimulated training of new farmers and also played a role in educating the banking sector. This helped in opening up credits for farmers who approached the lending institutions with proper business plans.

Efficient catfish hatcheries were established (with Dutch support) that realized **massive production of fingerlings** of known origin. Although African catfish is native to Nigeria, the parent fish of these new hatcheries originated from improved breeding lines. These lines had better growth and survival characteristics under intensive farming conditions and had been developed in the Netherlands and elsewhere. At present there are over 15 intensive catfish hatcheries and many other farmers are involved in small-scale fingerling production to meet their

own needs, selling limited quantities of surplus to others. Hatchery operators have enhanced quality control by applying best management practices. A competitive market has developed and fingerlings are more available. Techniques for shipping fingerlings via public transport have been developed.

The first intensive catfish farms relied on imported **high-quality fish feeds**. Later local feed production evolved, sometimes supported by foreign technical advisers. Complete fish feeds are now widely available and a competitive market for fish feeds has developed. Besides locally produced feeds Nigerian fish farmers have access to feeds imported from Holland and other EU countries, Israel, Indonesia, Brazil and USA.

Fish farm estates: a model for inclusiveness. Attracted by prospects of good profits, medium-scale investors (typically government civil servants and retirees) invested in farming African catfish in concrete tanks grouped in 'fish farm villages' or 'fish farm estates'. These were located in peri-urban areas near large markets. Having some capital but lacking the land, time and other resources these small investors employed others who were better qualified to manage their operations. Being well educated they managed to obtain credits from banks and launched catfish farms in groups of concrete tanks. One site near Ibadan started with 200 tanks (each tanks measuring 8 x 2 m) but later extended to over 600 tanks and 1100 small earthen ponds. This particular fish farm village is a cooperative of over 500 investors, managed by a supervisor with a small number of technicians. It is believed that the cooperative and business-minded spirit of the Yorubas, the dominant ethnic group in southwest Nigeria, has played a role in the successful development of this model. The fish farm estate model is popular in the southwest and southern part of Nigeria. The Federal Government has adopted this model to engage unemployed graduates and school leavers in fish production activities. Different models are tried in other parts of the country (T. Atanda, 2012, pers. comm.)

The technique and preferred fish species are very **suitable for small-scale backyard production** by people without access to land. Production from concrete tanks intensively stocked with catfish can reach 1.5 tonnes of fish per year from three 16 m^2 tanks, achieved in 2 production cycles. Due to low construction costs, relatively easy operation and increasing availability of fish farming inputs, thousands of concrete tanks have been built all over Nigeria, often within home compounds for easy management and security. Using small basins within the home compound also avoids bureaucratic procedures and disputes over land ownership that may affect fish pond development. In the initial stage profits for catfish farmers were up to 1 US $ /kg fish produced, but due to rising input prices and a growing supply (especially in Southwest Nigeria where catfish farming has been developed most) the profit level has reduced.

Nearly all fish are sold whole and consumed on the Nigerian market. Eighty-five % is sold alive, 10% is sold in smoked form and the rest in a different form (sundried, fileted, etc). These figures show that processing or value-addition takes place on a limited scale.

The total number of fish farms in Nigeria is believed to have reached 5000 in 2009.

Helpful partnerships

The development of catfish farming in Nigeria benefitted from long-term cooperation with experienced European and Indian firms for technical assistance in the field of farm construction and management, catfish breeding and fingerling production, supply of high-quality feeds and feed production.

Credit was provided by private banks (mainly for the more successful and educated farmers), and to small-scale producers from development projects supported by FAO and World Bank. Responding to the problem of high unemployment among young people the Nigerian government is training youth in aquaculture techniques.

Fish farmer associations have played a supportive role to the sector's development. These associations stimulated training of new farmers and also played a role in educating the banking sector. This helped in opening up credits for farmers with proper business plans.

Research institutes such as National Institute for Oceanography and Marine Research and the Nigerian Institute for Freshwater Research have provided support through research, training and capacity building.

Impact of catfish farming on small-scale producers and society at large

Catfish farming can be a profitable activity even on a small scale. Miller & Atanda (2011) provide the following data on costs and benefits from a small-scale production unit:

Table 2. Estimated fixed and operating costs and income from two 16 m^2 concrete tanks.

	Costs, US $, per tank and per harvest	Two tanks	2 production cycles/year
Tank Construction costs	615.38	1230.76	
Installation of water supply, other small equipment	184.61	369.20	
Direct production costs	567.00	1134	2268
Depreciation (20 yrs) & interest	50	100	200
Gross income from sale (240 kg fish/tank/harvest @ $ 3,09/kg)	742	1484	2968
Net profit	115	230	460

In a survey carried out in 2009 among 204 fish farmers in Anambra State (South Nigeria) Ugwumba (2011) found that 76% of them grew catfish in concrete tanks, using water flow-through and intensive feeding with complete commercial fish feeds. The average farm size was 162 m^2 and annual production was 3.9 tons of fish, the sale of which resulted in a net farm income of $ 5166.

Nigerian catfish farms supply approximately 120,000 tons of fresh fish to the local market, reducing the demand for imported frozen fish. A value chain has emerged that is supported by

investors and entrepreneurs at all levels from the supply side of equipment and services to production with infrastructure and feeds. Further downstream the processors and wholesale and retail marketers play an important role. This broad value chain has greatly diversified livelihoods.

Considering both up-stream and down-stream employment generated in the value chain of farmed fish, some sources estimate that some 1.5 jobs are created for each ton of fish produced (Fisheries Society of Nigeria and A. Atanda, Pers. Comm., Cited in Miller and Leschen, 2011). This seems a high figure (see for example par. 3.2 for an estimate of employment resulting from aquaculture production in Egypt) but if correct, total employment generated by the Nigerian aquaculture sector would be 180,000.

Farmers growing vegetables are benefitting from the aquaculture development using concrete tanks through the availability of irrigation water rich in fertilizer. An inventory revealed in 2003 that 40 to 50% of the fish farmers that used ponds combined this activity with poultry, pigs, goats or sheep and crops. A significant part of the waste generated by fish culture activities is a useful fertilizer for vegetables and other crops.

References:

Atanda, A.N.(2011) National Programme for Food Security - Pers. Comm.

Miller, J.W. and T. Atanda (2011) The rise of peri-urban aquaculture in Nigeria. International Journal of Agricultural Sustainability 9 (1); 274 – 281.

Miller, J. and W. Leschen (2011) Report of 'Regional Seminar on Commercial Aquaculture Development in African Countries Bordering the Atlantic Ocean (ATLAFCO), Libreville, June 8-10, 2011)

Ugwumba, C.O.A. (2011) Analysis of catfish farming system and its impact on net farming income in Anambra state, Nigeria. ARPN Journal of Agricultural and Biological Science, Vol. 6 (2): 26-30.

3. The recent development of aquaculture in Egypt

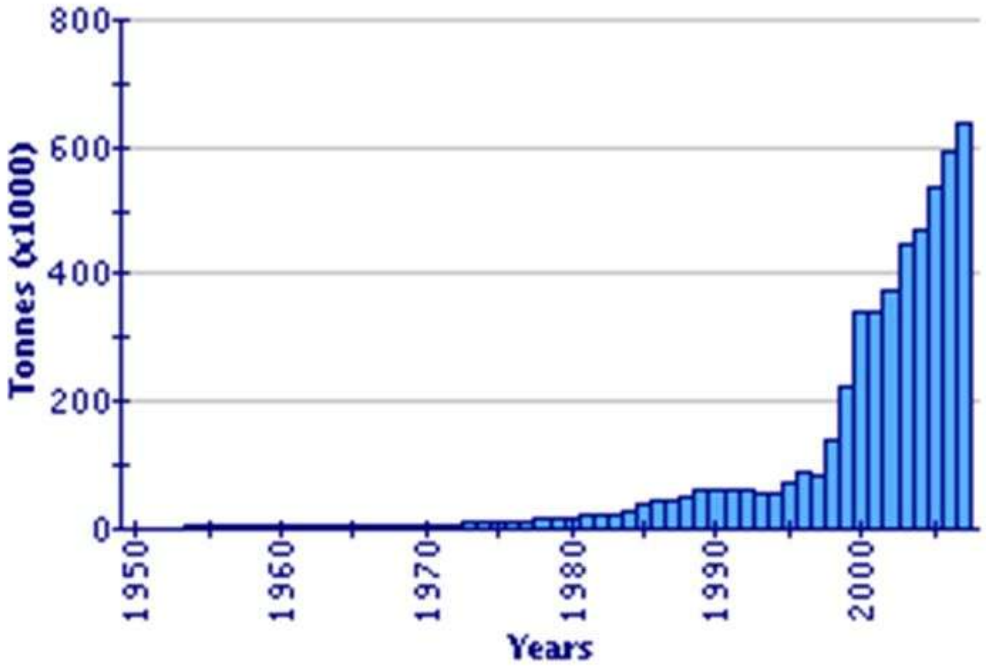
3.1 Highlights of production

With an annual production of 700,00 tonnes Egypt is by far the largest producer of farmed fish in Africa. Most of the production growth took place after 1995, when application of technical improvements of tilapia culture by existing private pond owners and new entrants led to more intensive production systems allowing a higher yield per ha. As result the number of traditional, extensive, family-owned farms is decreasing, being replaced by a growing number of intensive and semi-intensive farming operations.

Pictures in tombs and temples indicate that tilapia was held in ponds and basins in the times of the pharaohs. In the mid 1990's, Egypt re-discovered tilapia as an aquaculture species. Intensive tilapia production in ponds was introduced with the aim of replacing the semi-intensive and

extensive traditional carp and mullet farms. Farms applying the new techniques for more intensive production showed to have a high returns on investments and expanded. The example was replicated by other investors.

Figure 5. Production of farmed fish in Egypt.



Source: FAO National Aquaculture Situation Overview: Egypt.(FAO Fishery Statistic).

Intensification of production after 1995 was achieved by application of:

- using smaller and deeper ponds,
- higher stocking densities
- mono-sex culture with all male tilapia fingerlings
- intensive feeding with complete feeds of which the quality improved over time;
- aeration to enhance oxygen levels during parts of the day and night, and
- regular, partial replacement of the pond water.

The sharp increase of tilapia culture was made possible by a proliferation of private tilapia hatcheries and by animal feed producers starting production lines for complete fish feeds. Responding to the growing demand more than 350 private hatcheries and 14 fish feed factories are now in operation. Another source mentions the existence of 25 fish feed factories (Graeme Macfadyen et al/WorldFish Center, 2011).

The semi-intensive and intensive operations are largely owned by medium and large-scale (family) businesses and agricultural entrepreneurs. A survey in Kafr El Sheikh, the governorate where fish farming is most developed, revealed that 60% of the farmed area consist of farms in the 2 - 10 ha range, and only 4.4% of the farms are larger than 23 ha. Total area covered by fish farms is approximately 144,000 ha. An analysis of satellite images resulted in an estimate of the total pond surface of 104,000 ha in the Nile delta area only (ALTERRA,2010)

Average annual production attained in intensive pond farms is in the range of 15 to 25 tonnes per hectare.

Also the availability of brackish and saline soil and saline water sources in North Egypt (not suitable for most agriculture crops) for pond culture of tilapia and mullet, and the (partly illegal) construction and expansion of fish farms along the lakes in Northern Egypt have contributed to total production growth.

Integrated desert agriculture-aquaculture activities started in the late 1990s generally in the form of intensive aquaculture in concrete tanks and with aeration. The effluent of tanks in which intensive tilapia production (10 to 30 kg/m^3 tank volume/year) takes place, is used for irrigation of crops and trees. This form of aquaculture is now applied in a dozen of farms.

Fresh and brackish water fish species make up 98% of the total aquaculture production. Tilapia contributes 55% to the production. It is followed by Mullet (30%) and common & Chinese carp species (11%). The remaining part is composed of African catfish (3%) and marine fish species such as gilthead seabream, seabass, and shrimp.

The farming of fish in floating cages, mainly in branches of the Nile, started in the 1990's. In 1993 the total number of cages was 355 with an annual harvest of 340 tonnes; by 2009 production reached 68,049 tonnes. The number of cages has been reduced since due to strong opposition from groups concerned with the water quality of the Nile.

Thousands of small-scale rice farmers make use of carp fry freely distributed by the government and released in paddy fields. The fry are produced by the government or purchased by the government from private hatcheries. They are distributed to ensure a supply of animal protein to poorer farmers and their families. The carp that is harvested are too small to be marketable and are mostly for home consumption It is estimated that this government programme contributes to the production of 26,000 tonnes of carp.

3.2 Consumption & employment

Over 98% of farmed fish production is consumed in Egypt, contributing 65% of the country's fish consumption of 15.9 kg fish/caput.

The expansion of aquaculture has succeeded in reducing and stabilizing the cost of fish in Egypt, making a healthy and affordable source of animal protein, vitamins, minerals and unsaturated fatty acids accessible to the poorer population. Nearly all production is consumed locally. The chain between producer and consumer is short, and fish farmers receive a high percentage (> 70%) of the price paid by the consumers. Fish are sold live, fresh or on ice and post-harvest losses are very small. Nearly all fish is sold whole, without any processing or value addition.

No accurate statistics exist on the number of people involved in aquaculture and related activities. One source estimates that for every 100 tonnes of production 14 jobs are created in the chain between farm and retailer, which would translate in 98,000 jobs (Graeme Macfadyen et

al/WorldFish Center, 2011). The General Authority for Fish Resources (Government of Egypt) estimates the total number of people involved in aquaculture production at 70,000, divided into four groups:

1. The first are the land owners and those with Government issued land lease contracts for traditional fish farms. These people generally run a family business where all or most of the family members (sometimes two generations) work on or for the farm. These types of farms are generally labour intensive with a simple infrastructure and production technologies. Most of the farmers have only a limited education and apply production techniques inherited down through the generations. The total number of people involved in this type of activity has been estimated to be between 37 000 and 43 000 persons.
2. The second group includes people working in fish hatcheries, cage farms and intensive pond aquaculture. The majority of people working in this sector are hired staff and include trained technicians and skilled labourers. The estimated total is 25 000 persons.
3. The third group includes staff working at Government run hatcheries, fry collection stations, juvenile production facilities and fish farms. They have differing levels of education and training, ranging from highly trained experts to unskilled labour. The total number of governmental employees working with aquaculture in the field is approximately 1 000 persons.
4. The fourth group includes consultants, feed mill staff, engineers, transport, processing and other support activities. The number of registered consultants is 228 and the number of people working in fish feed production is estimated to be 540 persons.

In the first, third and fourth group, man power is of mixed gender, the second group however, is dominated by males with a few exceptions in some private hatcheries.

A fifth group, people working in sales and distribution of farmed fish, could be added. The number of jobs in this part of the chain is estimated at 5.5 per 100 tonnes of fish produced, equivalent to 38,500 jobs for 700.000 tonnes production (Graeme Macfadyen et al/WorldFish Center, 2011).

3.3. Potential, issues and challenges

The supply of fish to a growing Egyptian population will require that the sector maintains its growth. The cost of production of tilapia in Egypt is relatively low compared with most other producers, but export potential is unknown. Export to the EU is hampered by lack of product traceability, lack of conformation to food safety regulations (that among other things prevent import of fish grown in agricultural drainage water) and lack of knowledge of EU buyer and consumer demands.

Competition for water, land and space

Fresh water is limited in Egypt. With help from the British an extensive irrigation system was built in the Nile Delta. The law of 1983 has designated Nile water to be used for agriculture and domestic use. Fish farms, with the exception of hatcheries for freshwater species, are not allowed to use fresh irrigation water. With the extensive network of irrigation canals, Egypt developed also an extensive system of special canals and pumping stations that take care of drainage of water

from agricultural areas. Fish farmers are allowed to use the water in the drainage canal but this carries the risk of being contaminated with agricultural chemicals and domestic pollution. The aquaculture sector is lobbying for a change of the 1983 law, giving the sector access to the water in irrigation canals, but until now without success. Besides from water use, also the legislation on land use and lease terms could be reviewed in the light of their impact on aquaculture.

The proliferation of illegal ponds along the shore of lake Burullus and other lakes is opposed by fishermen who see their fishing ground diminish.

Although the over-all contribution of floating fish cages to organic matter and nitrogen levels of the Nile as a whole is most probably small (and far less hazardous than industrial pollution), the concentration of floating cages in some places is very visible, meeting public opposition and has already led to removal in some places.

Laws and regulations: some are supportive, others restrictive

Some sectors in the Egyptian government have been very supportive to aquaculture development, while the insistence on the present laws on water use by other government units is felt to be a hindrance to the sector's development. Export of farmed fish to certain markets is impossible due to the use of water from drainage canals to fill ponds and for partial replacement. There is also the issue of different interpretations of the regulations by civil servants at different government levels. Cumbersome permit procedures, forcing expanding and newly aspiring fish farmers to pass a large number of offices, causes frustration at the side of the private sector.

Now, one year after the January 2011 Revolution, the present appointed, transitional government has seen several changes of responsible people which has affected the effective response on matters with long-term impact. It is hoped that after the installation of the elected government (expected before June 2012) these issues will be addressed.

Rising price of fish feed.

Fish feed prices have risen 200-250% over the last 7 years. With fish feeds being responsible for 60 to 70% of the fish farmer's operational costs, this trend reduces the profitability.

Price and quality of other inputs

Poor quality of fish fingerlings and lack of available land for expansion are other factors that restrict further expansion of fish farming in Egypt. Fish farmers also mention difficulty with access to capital. Banks consider the sector high-risk and very few loans are provided to fish farmers. As a consequence fish feed producers/traders and fish traders are an important source of capital or credit.

Constraints in the field of marketing and distribution:

In real terms, fish prices are declining, while the price of inputs have increased. This affects the profitability for fish farmers. Consumers prefer wild fish over farmed fish and there is general distrust of frozen, filleted or processed products. This explains the lack of value addition. Over the year fish prices strongly fluctuate, with declining prices towards the end of the year coinciding

with the major harvesting period. (Most fish farmers harvest in November – December to avoid stocked ponds and the risk of mass mortality in the cold winter season). Fish hygiene and handling practices are poor throughout the value chain. There are few possibilities for fish export and in some cases poor road networks impact on the ability to get fish to markets.

Competition with imported fish products.
Also Egyptian fish producers face increasing competition from imported, frozen fish fillets from Asia.

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