Mission report

Egypt, 16 - 26 May 2009
Project BO-10-006-111 'Integrated Aquaculture Egypt'

Capacity Development and Institutional Change Programme
Wageningen International, the Netherlands

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ACKNOWLEDGEMENT

During the mission a number of Higher Education and research institutions, government departments and farms producing various products (fish, horticulture, livestock, other types of agriculture) were visited. The programme of the visits was prepared mainly made by Mrs Dina Hamdi and Eng. Sherif Rashed of the Egyptian Fisheries Council, who also accompanied us during most of the visits. We are very grateful for their support and pleasant company.

We also would like to acknowledge the kind help of Mrs Hennie Wellen of the Netherlands Embassy in Cairo, Mrs Nadia El Nokrachi of the Netherlands Consulate in Alexandria, Dr Ismail Radwan and all institute staff members and farm managers who showed us around and shared their experiences and insights with us.

1. BACKGROUND INFORMATION

Egypt has a rapidly expanding population and the government is concerned with future food security. The Nile is the nation's only renewable source of fresh water and this forms a bottle neck that sets limits to agriculture and its future expansion. Making use of this limited resource in the most efficient way is of great importance for Egypt (and for other countries with limited fresh water supplies). Egypt has a large fish consumption and a major part of the country's fish supply is already the result of aquaculture, especially the farming of tilapia (> 450.000 tons in the past year). Expansion of fish production can only come from the expansion of aquaculture because the catches from natural resources have already reached the limits of the carrying capacity of the marine and freshwater fish stocks. The improved integration of aquaculture (fish farming) into existing farming practices may offer the opportunity to expand fish production without demanding a greater share of the fresh water resource. In addition to water also nutrients will be used more efficiently in an integrated system. Practices in other parts of the world have shown that both agriculture and aquaculture can benefit from improved integration as result of synergic effects.

2. THE MISSION'S GOALS

Wageningen International has been commissioned by the Ministry of LNV to execute BOCI project nr BO-10-006-111 "Integrated aquaculture Egypt". The aim of this project is to asses the present state of integrated aquaculture in Egypt, and to identify opportunities for (improved) integration. This mission is the start of the project, and has as main objectives:

- To obtain an overview of present activities with regard to integrated aquaculture by talking with key informants;
- To see which sub-sections of Egyptian agriculture offer opportunities for integrated aquaculture. Opportunities could be in the form of:
    - availability of waste products that could be useful inputs in aquaculture;
    - need for water and fertilizer water that could be supplied by aquaculture;
- Identify the most promising types of integrated aquaculture under Egyptian conditions.

3. MEMBERS OF THE MISSION

The mission was undertaken by:

- Marc Verdegem, professor in Aquaculture at the Aquaculture & Fisheries Group of Wageningen University;
- Peter G.M. van der Heijden, scientific staff member of Wageningen International working in the field of fisheries management and aquaculture.

Both Verdegem and Van der Heijden have worked on the integration of aquaculture and other types of agriculture in the past in the Philippines, Bangladesh, Zambia, Vietnam, Costa Rica, Thailand, Malaysia, Indonesia and Egypt in research or extension projects.

The itinerary of the mission is found in Annex 1.

4. REPORT OF MEETINGS AND OF VISITS TO FARMS AND INSTITUTES (in chronological order)

May 16, 2009

French Group
Present: Mr Shawky (poultry specialist) and Mr Jamel (General farm manager), Dr. M. Emara (owner), Peter van der Heijden, Mr. Sherif Rashed

The farms of **French Group** that were visited are located 90 km NW of Cairo and are owned by Dr. Mahmoud Emara (chairman), an Egyptian who is also French citizen.

Farm 1 is a fruit tree & duck farm of 70 feddan (= ± 70 acre; 29 ha) that produces mango and citrus seedlings (1.5 yrs old), varieties Heidy, Kent and Kate. There is also a new yard with grapes (variety: Spiria and Flames, for direct consumption and probably export to Italy, no harvest yet).

The farm also produces one-day duckling, hybrid Muscovy (m) & Peking duck (f). They have 20.000 Peking ducks and 1350 Muscovies. Ducklings are produced by artificial insemination, ratio M : F = 1 : 15. Hybrids are called mullards. The farm produces 750 000 mullard ducklings/ yr, plus 0.5 million Muscovy ducklings. At present all ducklings are sold in Egypt, because due to avian flue export is not allowed. Due to precautionary measures against avian flue and quarantine we could not visit the ducks. The duck feed is mixed on farm. Duck manure is used to make compost which is used in the fruit farm. In the duck hatchery work 12 people. On this farm is one well; pump capacity is 115 m^3/hr. Pump works about 2 hrs/day, but more during the summer. The well is 220 m deep. This part of Egypt has become very productive during the past 2 decennia relying on large fossil water reserves.

Farm 2 (also part of French Group) is 3000 feddan (1230 ha). It consists mostly of fruit trees (mango, peach, citrus) and grapes. This farm has also 7 ponds in size ranging from 0.3 to 1.4 ha. The culture is extensive, but very recently electricity became available on site, and the plan is to put in aeration equipment in two circular tanks of 0.3 ha (cement sides and bottom) to raise productivity. Water from the ponds is used to irrigate the trees. The total stocking density is 30 800 fishes per ha, consisting of 26000 tilapia, 2400 African catfish and 2400 mullet. Tilapia fingerlings are bought from a private hatchery, mullets and catfish are bought from government hatchery, at:

- Tilapia: 200 E£/1000 pieces, 3 – 5 g/fish
- African catfish: 100 E£/1000 pieces, 5 g/fish
- Mullet: 1000 E£/1000 pieces, 5 g/fish

The ponds are not fertilized but probiotics imported from Thailand are applied. The probiotic should help to mineralize waste and dead phytoplankton, reduce excessive algae growth and improve water quality.

Tilapia is harvested intermittently by seining (2 inch mesh size) from September to April , market size is > 250 gr. A sinking 33 % protein fish feed is applied, cost 2700 E£/MT, plus a floating (extruded) feed (cost 3500 E£/MT). A Feed Conversion Ratio (FCR) of 1.6 is realized. The farm produces about 40 tons fish /yr. The fish is sold to fish traders from Cairo. The price is:

- Tilapia: 11 E£/kg
- African catfish: 7 E£/kg
- Mullet: 22 E£/kg.

Fish prices are now high due to avian flue.

No problems are experienced in the fish farm, only when there is strong wind all feed is blown to the shore. In the round concrete tanks feedings stations made from small plastic baskets are applied that prevent the floating and sinking feed from being wasted in times of strong winds.

Photo 1. Very large concrete tank in French Farm

Photo 2. Feeding station to avoid loss of floating and sinking feeds used at French Farm

May 17, 2009

WorldFish Centre (WFC) in Abassa
Present: Peter van der Heijden, Mrs. Dina Hamdy.
Talked with Dr Malcolm Beveridge, Ir. Ahmed Nasr Allah and Dr Ahmed Rahman.

In 1997 the Abassa station was offered to ICLARM (now called WorldFish Center) by the Egyptian government. The area that was made available to ICLARM consisted of half the area that belonged to Central Laboratory for Aquaculture Research Centre (CLAR), a national research center under the Egyptian Government. The WFC Abassa station includes 100 ha of ponds, a garden, training facilities, various labs, a hatchery, a library and offices. ICLARM has upgraded the facilities and focuses on research aimed at poverty alleviation. Fish farming in Egypt took off since training given by Mr Pedro Padlan (Phil) in the 1980's. The discovery of ground water in the Delta region (partly fossil, partly renewable) triggered the development and establishment of aquaculture. That area was waste land before with no value.

The attitude of the Egyptian Government towards aquaculture is described as somewhat two-sided. At least 4 Ministries are involved (Agriculture, Irrigation, Environment, Planning) of which some are supporting and others are limiting aquaculture development.

The export to Europe of fish grown in surface waters in the Nile basin is difficult because the EU fears that the accumulation of pollutants in the fish could be unacceptable high. The farms depending on ground water (fossil water) can on the other hand claim an organic status and can obtain certification.

At present two major issues are affecting Egyptian fish farming:
- The competition from imported Pangasius (Basa) filets. The panga filets that enter the market are very cheap.
- Avian flue. Besides from affecting the demand (and price) for fish in a positive way the flue has also affected the use of poultry manure in ponds. Chicken manure is now more difficult to get: the transport has been restricted. (There are plans by an Arab company to build a poultry arm in the dessert that would produce 1000 tons poultry /day!!!)

In 2007 fish feed prices were high, but fish prices were low. Some fish farmers stopped or stocked less fish. In 2008 fish became more scarce, the price went up and feed price went down. As a result the fish farmers are doing well at this moment.

Water: 83 % of available fresh water was used by agriculture in 2000 (Nile basin Initiative, 2005), and this has to be used more efficiently. The WFC research focuses on pond productivity and water issues. WFC research is focused on genetics (they have > 100 fish family strains), marketing & socio-economic aspects, fish health and nutrition. The genetics research is using selection as a way to improve growth and filet yield related traits. WFC does not apply super male technology.

Officially the use of methyltesteron is not allowed in Egypt but most tilapia hatcheries are applying it to produce all-male fry and fingerlings.

Egypt has a cold winter and a limited growing season. So there is in general early harvest (October – January), and farms have some problems with fish overwintering and weak stocks→ there is a growing and general use of probiotics in ponds.

WFC has been doing research on the culture of rice and wheat in ponds. During the visit some ponds had a deeper area with water and small fish, and rice had just been sown on the elevated bottom. In other ponds there was winter wheat that had been sown early December, after the fish had been harvested. During my visit the wheat was harvested with a combine harvester (picture). The wheat yield was higher than the average wheat yield obtained in a farm. There has not been much research on the combination of fish and other animals at WFC. We heard that CLAR was planning to undertake research on duck-fish combination.

Photo 3. Wheat harvesting from fish pond at WFC.

Photo 4. Concrete fish holding facilities at WFC.

WFC has recently studied the water balance of ponds (measuring the water input, water loss through seepage, evaporation and discharge before harvest). This was done in Abassa but also in other parts of Egypt. As a general result the average water use was 3.6 m^3 of water per kg of fish. The biggest water loss was through evaporation, which was around 5 mm/day (but very much depending on the season).

The Egyptian law prohibiting fish farmers to use irrigation water is still in effect. However, in Kafr Al-sheikh area irrigation water is supplying 23000 feddan of fish farms.

In 1991 fish arming in cages was banned, but a production of 50 000 tons of tilapia from cages in 2006 developed none the less, despite the ban. After complains about pollution the cages were recently removed.

Discussion with Dr Ahmed Rahman, Senior Scientist responsible for training at WFC.
WFC offers short courses and trainings, with 200 to 250 participants/year. The training courses are local (for Egyptians), regional and international. In some cases trainees are also taken to the training centre of Dr. Ismail Radwan. Trainings are organized in cooperation with EAgA, JICA, and others. Local courses also touch upon fish farm management, technical and economical feasibility, HACCP fish quality, etc.
Integrated aquaculture is sometimes discussed in courses given at the WFC. The subject is also touched upon in courses discussing the role of fish farming in rural development.

Discussing on how to measure the impact of training on aquaculture sector development Dr Rahman gave the example of the impact of a training given in Fayoum area. Before the training the pond productivity was 400 kg/feddan, the farmers applied the technology discussed in the training course and asked many follow-up questions in the yea after the couorse. The number of follow-up questions decreased over time, the yield increased to 3300 kg /feddan after 3-4 years and the famers now aim for 5 tons/feddan. This study was part of the international AquaFish Collaborative Research Support Programme (ACRSP).

The Netherlands has supported a grass carp reproduction & fingerling production programme of the Ministry of Irrigation in 1970's and 1980's. At present this ministry still has hatcheries that produce and stock grass carp in lakes and canals.

The Egyptian government has promoted rice-fish farming but this program can not be called a success. An area of 400 000 feddan is supposed to be under rice-fish culture. The carp fingerlings (fry?) are supplied free of charge. Dr Rahman believes that the official figure for carp fry production is too low and should in reality be > 1 billion. The carps that are harvested before the rice harvest are too small: only 50-70 gr. This size of carp is not popular due to the large number of small bones. Most likely, the temperature in the rice fields is too high, hence the fish spends most of its energy on its own fast metabolism, leaving little energy to invest in growth. In rice field culture, deep refuge areas should be present where fishes find cooler water to escape excessive heat.

Some years ago the government asked farmers to pay for the carp fry and as a result the demand dropped severely. The next year the carp fry were distributed again free of charge. This is also done to make the large available hatchery capacity productive. The result of the carp-rice integration differs per region. Important success factors include the quality of the extension worker (his commitment to oversee proper distribution and stocking) and the pick-up drivers: success is related to incentives given to them to distribute the fry quickly, to the right places, in the early morning, in bags sheltered from excessive heath, etc.

Use of insecticides in crops is now much lower than in the 1960's (reduced to 10%, as was roughly estimated). Use of copper sulphate is still common to control excessive algae blooms.

The Egyptian government has a water use strategy that includes reduction targets of water use for certain crops or forms of agriculture. There are maximum limits set to the use of land for sugarcane and rice to conserve water.

Many believe that aquaculture pollutes the environment but in Egyptian aquaculture hardly any chemicals are used (sometimes bleach to disinfect the pond bottom). Medicated feeds are used rarely. Pond outlet water is often cleaner than inlet water. Only during complete drainage for harvest does the water contain sludge with high BOD (organic material) content.

Egypt does have a very high fertilizer use (number 3 in the world, after the Netherlands). The use of organic manure in aquaculture and agriculture seems to decrease. For intensive fish arming it compromises the water quality and its use is too tedious.

One obvious waste / resource that is abundant and at present causing trouble is rice straw. Now it is often burned, which is officially forbidden but commonly done, and this causes air pollution.

Much expertise on the characteristics of crops in dry and saline conditions is available in the Dessert Research Institute.

May 18, 2009

Rahab Farms
Present: Dr. Ismail Radwan, Eng. Sherif Rashid (EAgA), Peter van der Heijden, Marc Verdegem.

We were guided around the fish farm by Dr Ismail Radwan. The farm is owned by Eng. Abdel Fattah Ragab from Alexandria. Besides agriculture, he's also involved in a shopping mall (Ragab Plaza), Cars (Ragab Motors) and customs (Ragab Bonded). This farm has approximately 200 staff plus workers, but in harvest season up to 2000 people can be employed. Per day of seasonal labour the company pays E£ 30 to the labour contractor. In the fish farm about 20 staff + workers are employed permanently.

The size of the farm is about 1500 acres of fruit trees and 120 acres of fish ponds. Fruits include strawberry and grapes as main crop, but also nectarine, apricot, peach, grapes, laquat, sugar apple, orange and mango. The farm pays only E£ 1000/acre/yr for irrigation water. Fertilizer is about 30% of the fruit production cost. Each crop has its own specific demand for fertilizer composition. Brand names are Nature's Best, Agroventura, Ragab and Celestial. Produce is for domestic consumption plus export, also to the Netherlands (from where it is distributed to rest of Europe). Also some ornamental flowers are produced, including Hibiscus, Bougainvillea and Helitroop, in cooperation with a Dutch horticulture firm.
The total water use of the farm is not known. Used water goes to a separate drainage channel system and leaves the farm (or dries up). The farm has a compost unit that uses rice husks and cattle manure.

Fish species produced are mainly tilapias, and low densities of catfish (*Clarias*) and mullets. In Egypt the price of catfish is increasing.

Basa (*Pangasius*) imports are today imported for prices a slow as 7 E£/kg. When pangasius imports in Egypt started the price was 32-35 E£/kg. The original imported product contained a lot of water (glazed up to 40 %). Now a maximum of 20% is allowed. At the same time the price declined to 7 E£. The news that use of human excreta in Vietnamese fish farming is common was made a big issue in Egyptian media.

Fish culture practices:

- A floating pellet is used. Starter diets contain 40% protein. Grow out diets for ponds contain 25% protein.
- There was a lot of variation in sediment properties of ponds. Some ponds have a high seepage of 2-3 cm/day. The productivity reaches 4-5 MT/acre/crop. In ponds with little seepage, more nutrients are accumulating in the bottom, consuming oxygen, limiting pond productivity. These ponds reach a maximum production of 2 MT/acre.
- Tilapias are reproduced in a greenhouse in 3 x 10 m tanks. 30 females and 10 males are stocked per tank. After 10 days the tanks are harvested. The fry are harvested and sex reversed using a diet with methyltestosteron for 3 weeks. Eggs are incubated in glass jars. The broodstock is put aside for at least one month, before being used again. Reproduction starts as early as February.
- After 3 weeks on hormone diet, the fry are harvested, and transferred to outdoor ponds. Half of the surface of the ponds is covered with plastic. This raises the temperature by 2^{o}, max. 3^{o} C. This is however enough to be able to raise fry already in February/March. The plastic cover is in the middle of the pond, with a concrete drain canal in the middle. The fingerlings can swim from under the plastic cover to the edges of the pond. From mid May, the plastic covers are removed, as the temperature in the ponds then becomes too high.
- The fish can be maintained during winter because the ground water is warm enough. However, fish do not eat or grow during the winter (November-February) in the ponds.
- At a size of about 1.5 – 2 g the fry are collected and transferred to grow-out ponds. At this farm the stocking density is 10.000 fishes per acre. The target size is 450 – 500 g/fish.
- Last year the farmer produced 300 MT (with 120 acres), and hopes to raise production to 400 MT this year.
- With a 25% protein diet the FCR is 1.5. In intensive recirculation farm with a 32% protein diet the FCR is 1.0. The price of the feed is 2500 E£/MT for 25% diet; 3500 E.P. for 32% protein diet. Today, the price for tilapia is 16 E£/kg.

Photo 5. Harvesting tilapia fry at Ragab Farms

Photo 6. Ponds with self feeders at Ragab Farms

While talking about the idea of integration and efficient use of water the owner offered to pump the pond water back into the irrigation channel. This would be done more to demonstrate his commitment to water conservation (political objective) than from an economic efficiency objective. Because the fish farm is the lowest lying section of the farm, this would mean extra costs for pumping.)

The fish farm manager (Dr Radwan who works as a consultant on this farm on a commission basis) took us to see his private 13 acre farm where he likes to set up an intensive Tilapia operation using recirculation system linked to vegetable and fruit production. He has a well, a pump, electricity (2 phase), but lacks a transformer to get 3 phase current needed to rum pumps of sufficient strength. Unfortunately, he does not get permission to install a transformer from the Ministry of Irrigation.

May 19, 2009

Dr. Ismail A. Radwan Farm/ Egyptian Aquaculture Center, Khafr el Sheikh Governerate.

Present: Dr. Ismail Radwan, Mr Mohamed (son-in-law), Mrs Dina Hamdi, P. van der Heijden, M. Verdegem

When arriving at the farm, grading and selling of 1 – 1.5 gr Nile tilapia fingerlings was going on. The buyer was growing tilapia some 300 km away, and the expected journey time was 3 hours. Before counting the fry were graded into 2 size groups, and each group was counted, by counting one scoop of each size group with a small strainer, and then counting the number of scoops.

Dr. Radwan gave a small presentation about his views on fish farming. A map was shown with the location of the farm, and the salinity in the area. Actually, the farm area is brackish. Groundwater is pumped from 40 m depth with a salinity of 12 ppt, and the land could not be used for regular agriculture. Tilapia farming developed from the early 80's.

In 1998 one kg of tilapia sold for 11 E£ in July, and dropped to 8.50 E£ in October-December. In 2002 the price was rather stable over the year at about 7 E£ per kg. The price stayed low till last year, while over the same period average feed prices doubled. Since last year, the feed price has dropped with 500 E£ per MT.
Today, it's possible to make a net profit of 20,000 E£ per acre per year.

Visit to farm facilities:

- The farm consists of 5 ha of hatchery and 5 ha of production ponds (8 ponds).

- Hatchery: 30 ponds of 2000m2 (with central plastic cover) and 2 halls for breeding. Breeding tanks are 12 tanks of 8 x 3 m, each stocked with 30 females and 10 males, and fry and fertilized eggs are collected after 10-12 days. Each female produces on average 700 eggs. Fry are immediately fed with a diet with methyltestosteron, added in the diet through an alcohol solution. 3 weeks later at 0.1 g the fry are transferred to nursery ponds. Stocking density is not known, but the fry grow to a 1 to 1.5 g fingerling size in one month. In winter, the nursery ponds are used for overwintering.
- In winter the water temperature can drop below 12o C. Reproduction starts the first week of February, and the first fingerlings are sold in April. He is able to get 60-70% of the fingerlings through the winter. The temperature of the ground water is 22^{o} C year round, and this also helps to increase fingerling survival during winter.
- Fingerlings are sold at 100 E£ per 1000 1-g fingerling. Other farms sell fingerlings at 30 - 40 E£ per 1000 pieces of 0.1 g each. Besides from a larger size fingerlings Dr Radawn also sells earlier (in April) than most other farmers are able to do.
  In total, 20 people, inclusive Dr. Radwan work in the farm.
- One 40 m deep well supplies 12 ppt water to the farm.

Recirculation system:

- 2 units with each 12 basins of 3 * 8 * 0.6 m, with a water turn over rate of 1 hour.
- 1000 fishes were stocked per tank, at 170 g average weight. After two months the fishes weigh now 300-400 g each. A 32% floating pellet is used, and feed from different feed companies is tested. The expected FCR is about 1. Unfortunately, tanks are not followed individually to calculate FCR's.
- The water flows through an open channel to a sedimentation tank. This is a 3 m deep tank of 7*13*1.8 m which is used as a sludge settling basin. Every 2-3 days the sludge is vacuum cleaned from the sump section of the sedimentation tank, and drained onto the surrounding agriculture land.
- From the sedimentation tank the water is pumped to a trickling filter (1.8 m high and a volume of 120 m^3).
- At present, 50 kg is fed per day. The inflow water is saturated with O_2 (8.5 mg/l, temp 27 C), the outflow culture tank water contained 6.5 – 7.0 mg O_2 / l.
- For the biofilter substrate Vexar ½ "mesh screen was cut into 20 * 20 cm pieces and rolled into biofilter tubes/rings.
- If the volumetric surface area of the biofilter rings is 150 m^2 /m^{-3}, then a biofilter of 66 m^3 should be sufficient.
- The water replacement is estimated at 10% per day. At full operation 450 l of water is used per kg fish produced.

Photo 7. Bill board of Egyptian Aquaculture Center of Dr Radwan

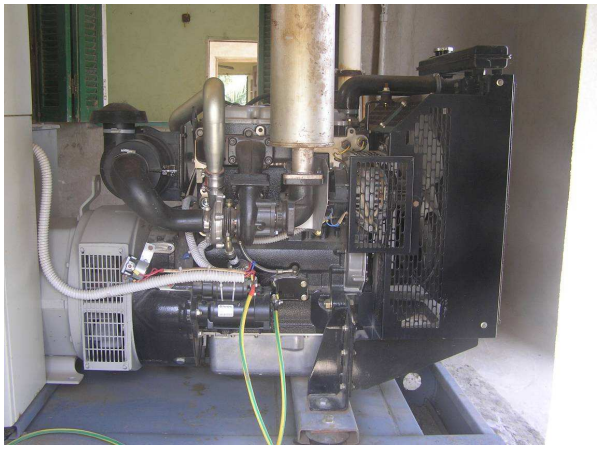

Photo 8. Generator at Dr. Radwans farm (back-up for the recirculation system)

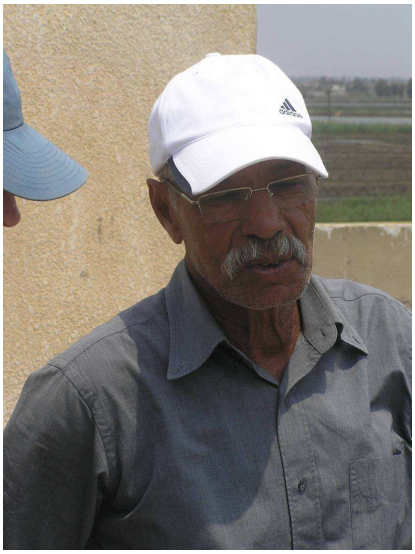

Photo 9. Dr Ismail Radwan

Photo 10. Self-made biological filter at the Egyptian Aquaculture Centre.

Photo 11. Fishponds in Governorate Kafr El-Sheikh

Mr. Radwan thinks the best integrated farming system would be a high intensity (10 kg m^{-3}) recirculating aquaculture system, from which the water and sludge are used for irrigation and as fertilizer for crop or fruit production. Both drip irrigation and open furrow channels are an option. An extensive aquaculture system cannot be integrated profitably with other types of agricultural production. Dr. Radwan was hesitant to say something about integration of fish with other types of animal production because he has no experience with this. Dr. Radwan does not consider manure input in combination with feeding as a good option for integrated farming.
He believes that maintaining a favorable water quality, through sufficient water exchange, is the key to successful tilapia production in ponds (up to 5 MT per acre).
Applying a high C/N ratio in nursery ponds was proposed to improve FCR and production, and to improve the overwintering conditions.

Around Kafr Al-sheikh the soil is to saline for regular crop production. By using irrigation water to fill the ponds, salinity is washed from the sediment through percolation. In this way plots of saline land are made suitable for agriculture.

May 20, 2009

Netherlands Embassy

Present: Frits Mönking, RaboBank – Horus Food & Agribusiness Fund, M. Verdegem, P. van der Heijden.

Horus Food & Agribusiness Fund is an investment fund that helps setting up new companies in the Agricultural sector. Only large enterprises can apply as the minimum investment is high. The fund has not yet many successes in Egypt as few investors can come up with a good business plan and have the rigor and discipline to implement it. Mr. Mönking favors joint ventures combining Egyptian with non-Egyptian companies.

Involvement of the Fund with Marine or Freshwater operations of the investment fund is limited. Mr. Mönking gave a few examples:

- At the Mediterranen coast, east of the Suez Channel a large marine shrimp farm was constructed. The farm is adjacent to a power plant, and cooling water is available. Using the power plants' cooling water was suggested by an Belgian expert but this has not yet been applied.
- A firm wants to process wild caught tilapia from lake Nasser in Cairo.

Farmer's cooperatives do exist in Egypt but these were set up by government and government does place some members in the board. Most cooperatives have not been successful in Egypt and the word 'cooperative' does not have a positive connotation with most farmers.

Ain Shams University, Department of Animal Production / Egyptian Aquaculture Recirculation Project.

Present: Prof. Amin El-Gamal , Dina Hamdy, H. van der Beek (Agriculture Counselor, Dutch Embassy), P. van der Heijden, M. Verdegem.

Prof. Amin El-Gamal is a PhD graduate from Stirling University, where he studied in the early 80's. He specialized in tropical aquaculture, with focus on integrated farming and recirculation technology. After his study he became Prof. at Ain Shams University. He constructed a large hatchery in 1992 to produce tilapia fry and fingerlings. At the time of construction, the price and demand for tilapia fingerlings was high (E£ 120/1000 pieces) and energy prices were low, but today the price and demand are low (20 to 40 E£/1000 pieces), energy prices have increased enormously and producing tilapia fry or fingerlings in a recirculation system is not profitable.

- Dr. El-Gamal would like to produce fingerlings of *Clarias gariepinus* (African catfish). One of the major bottlenecks is the high mortality due to cannibalism during the juvenile rearing stage.
- Dr. El-Gamal presented a plan for 'Aquaculture Development and Technology Transfer', with focus on recirculation technology, high intensity culture of eel and African catfish, and simple fish processing techniques to improve the marketability and added value of the products.
- One special request was to help upgrade the 1992 hatchery. Dr El-Gamal has tried to contact HESY BV to assist him with improving the recirculation system which is at present not functioning. (Hesy B.V. = Dutch company specialized in building recirculation systems).The system is big and consists mainly of concrete tanks and channels/gutters making it very difficult to make changes in the overall layout. Most likely, building a new hatchery will be cheaper than trying to remodel the existing facility.
- Dr. El-Gamal thinks WorldFish Center's research is not useful for Egyptian aquaculture. The Center has a mandate for Africa, and focuses on problems not of direct relevance to Egyptian aquaculture. He was not aware of any research results or publications by WFC-Abassa.

- Dr El-Gamal believes that integrated farming has the highest chance of success on big farms that can accommodate the various components. Achieving integration through linking the production of different small farms will be difficult due to the closed minds of the peasants, land ownership issues, and the different requirements for water of fish and crops during the year. Farmers do not easily cooperate and their trust in the government and in scientists is limited.
- Integrated rice-fish farming is propagated by the Government. Both state owned and private hatcheries are involved in the supply of common carp fry (*Cyprinus carpio*). About 300.000 feddan are stocked annually, with a production of 25-80 kg/feddan. Fry are distributed for free. Dr. El-Gamal considers the program a big failure. Large fingerlings of ± 100 g each should be stocked, so that common carp of minimum 500 g are harvested. But such larger fish are not available for stocking. The smaller fish that are now harvested are only fit for home consumption. Egyptian consumers do not like the numerous interstitial bones, especially in small carps.
- Egyptian universities have a limited number of places available. Students are admitted based on their high school grades. Students with high grades opt for careers in medicine, law, business management or engineering and have a higher chance of entering in the preferred course. Agricultural studies are low on the priority list, hence only low grade students enter the Faculty of Agriculture. The whole university has more than 100 000 students, but only ± 350 students enter the Faculty of Agriculture each year. Of that ± 30 students enter the Animal Production Department. Students are trained at BSc level in a 4-year study program. The aquaculture training is limited to a few courses. Dr. El-Gamal was very disappointed in the proficiency of his students, and the effort put by students in their study.
- The education in aquaculture received by the students is only theoretical, there are very limited possibilities to obtain practical experience. Dr El Gamal has not sufficient budget to do research.
- Dr El Gamal also has his own fish farm where he sometimes employs his students. He believes there is a demand for well qualified aquaculture staff from companies but the present educational system does not 'produce' them.

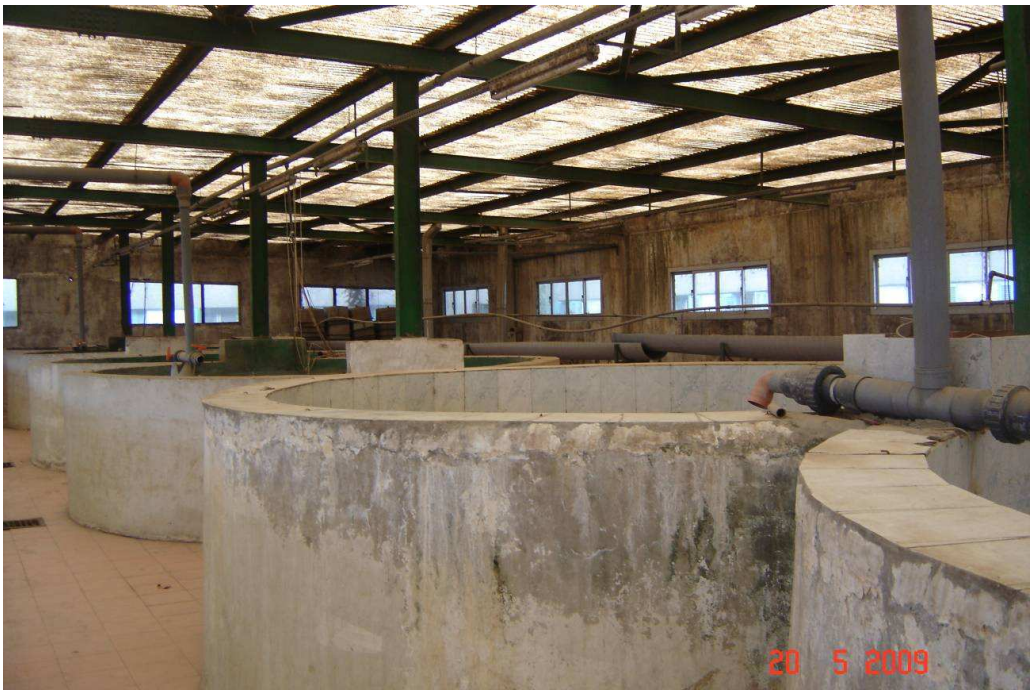

Photo 12. Concrete tanks, part of recirculation system of Al Shams University

Prof Dr. Mohamed Fathy Osman, President of Genereal Authority for Fish Resources Development.

Present: M. Verdegem, P. van der Heijden, H. van der Beek, Dina Hamdy

Mr Fathy Osman studied aquaculture in Stirling, and he was in 1985 three weeks in Wageningen.

Dr Osman believes integration is important because of water scarcity. He is in favor to give irrigation water (first use) right to fish farming. Ministry of Irrigation seems slowly to get convinced but they argue that this will need a major overhaul of the national irrigation & drainage system. Now drainage water and irrigation water have separate channels, drainage water ends up in the northern lakes and the sea. To conserve water there is a proposal to mix drainage and irrigation water (According to the Nile Basin Initiative, 2005, this has already started). A change of Law that would give irrigation water use rights to aquaculture has been proposed 1.5 years ago, but it is not known when it will be discussed in parliament. The present law on water use rights was passed in 1983, when fish farming was nearly non-existent in Egypt.

In northern Egypt fish farmers are developing ponds on the shores of a shallow lake, that is plagued by a gradually declining water level in recent years. As a result, the lake has shrunk from 1 million feddan to 230 000 feddan. Fishermen are protesting. Fines did not stop the farmers from digging new ponds. Now they are threatened with imprisonment and this is more effective.

Because now fish farming can only legally use drainage water farmed fish from Egypt can not be exported. Ministry of Irrigation has plans and predictions of future water use of the country. On the other hand there are already 23000 feddan of fishponds in Kafr Al-sheikh area that use fresh irrigation water. According to water use statistics 0.3 billion m^3 water is used for fish farming, on a total of 68 billion m^3 irrigation water. Mr Osman gives rough figures that show that fish can be grown with less water/ton production than is the case with many food crops, and such figures seem to make the Ministry of Irrigation re-think its policies regarding aquaculture.

The following existing practices and cases of integration of fish farming in other agricultural activities were mentioned:

- El Hoda Farm (where tilapia is grown in irrigation water storage ponds), French Group Farm
- There is El Keram integrated farming project near Sinai area: they use pumped water for tilapia culture, waste water is used for catfish farming, waste water from the catfish ponds irrigates and fertilizes an alfalfa crop; alfalfa is fed to goats and sheep, and goat and sheep manure is used to produce biogas which is used to heat a tilapia hatchery. The owners are not very open about this system.
- There is a small-scale aquaponics project for schools etc, funded by JICA.
- The Dessert Research Institute does research into integrated (fish)farming.
- Fish-Rice: This is taking place thanks to carp fingerlings being distributed for free to rice farmers, total area covered is 300 000 feddan. In 120 days a carp crop of 25 to 70 kg carp /feddan is grown. Carp is for home consumption, there is no market for small carps for consumption in Egypt.
- CLAR is planning research on duck-fish-rice integration.

There are also land use issues affecting integrated aquaculture: conversion of land use from aquaculture to agriculture is legal, but the other way around is illegal. This prevents application of systems that alternate agriculture and aquaculture. This law is applicable only to old agricultural (black) soils. Temporary use of black land for aquaculture is possible if this has no effects on neighboring lands; flooding a field for fish faming can cause water logging in neighbouring fields.

Due to avian flue poultry manure can now only been used on neighbouring farms, it is forbidden to transport manure further away. Chickens can be moved within a governorate, but the exact details of the regulation are determined by each governor and can be different between governorates.

The growing of winter wheat on pond bottoms is a great system but can not be applied legally: if land is suitable for agriculture the law states that it should not be used for something else!

Many Egyptian consumers prefer wild-caught fish over farmed fish. Dr Fathy Osman told anecdotes of fish sellers who put farmed fish in traps in River Nile to cheat clients with so-called "freshly caught wild fish".

The Ministry of Agriculture has a special extension service with mostly staff that are over 55 yrs old. They studied extension and can never move to other jobs in the private sector because there is no demand for extension agents in private farms. There are no specialists in aquaculture available for extension.

A proposal about controlled testing of cage farming (proposed by EAgA) was discussed. Various ministries deal with cage farming: Irrigation, Environment, etc. So far the proposal did not yet receive the signature for approval.

May 21, 2009

Wataneya farm, Salheye
Present: P. van de Heijden, Dina Hamdy, M. Verdegem
Farm manager: Celine (Seim) Mona

Mrs. Mona is a graduate from Ain Shams University, Agriculture program. In the past, when she was an employee of the Ministry of Agriculture, she made study tours to Italy, Greece and the Far East. She got her idea to start an integrated farm mainly from her visit to the Far East. She stays 5 days per week on the farm, and spends two days per week in Cairo with family. Her husband manages another farm.

The farm started in 1998 on 60 feddan of unused land. Mrs. Mona is the manager of the farm, where 5 permanent laborers are employed. When necessary, more laborers are hired on a temporary basis. Wataneya farm is an integrated farm producing tilapia, chickens, vegetables (cucumber, tomato, banana, wheat, pepper, mango) and flowers (gladioles and others). For crop production fresh water from Lake Ismailia is used, plus ground water and fish farm effluent. Only groundwater is used for fish culture. Water in the concrete fish basins is replaced at rate of 25 to 35%/day (Mr Ahmed Nasr says it can go as high as 60%/day in the last stages of the fish production cycle). Water is already available at 3 m depth, but the farm pumps water from 70 m depth. The water from lake Ismailia is available to Wataneya farm free of charge, 200 E£ per year is paid for the use of ground water. All tanks are aerated with air blowers. In total 5 air blowers are used on the farm. In outside tanks paddlewheels are placed.

From all products on the farm Mrs. Mona considers tilapia the most profitable crop, followed by banana. Other vegetables and flowers are less profitable.

On the chicken farm fertilized eggs are produced farm (150 000 layers per year). A large fraction of the chicken manure is sold (every 45 days, 3000 – 4000 E£). Some manure is put in bags in the drainage/irrigation pond, to release nutrients in the water before this is pumped to the fields for crop production. Chicken manure is sometimes also ploughed into the soil before planting.
In the drainage pond tilapia, grass carp, common carp and silver carp are placed, and this results in 2000 kg/year from this pond without any extra feeding. The fish waste water flows from the drainage ponds to the sprinkler irrigation systems. Sometime, a sprinkler gets clogged, but it's easily opened by a worker with a needle. Until 2 years ago Wataneya farm also raised ducks, but this was stopped because demand for ducks is seasonal (parties, holidays, etc).

Mrs Mona reckons that by applying fish farm effluent she reduced fertilizer input on her farm by about 50%. A MT fertilizer costs 7000 – 8000 E£. Fish is harvested every 3 months, and auctioned in Cairo. The fish is mostly sold in one day. Presently 15 E£ is paid for 1 kg of tilapia, which is a very good price. Because 25^0 C ground water is pumped through the farm, a reasonable production can be maintained year round. Electricity costs only E£ 0.13/kWh.

There are different suppliers of fish feed, and Mrs. Mona switches between fish feed producers, selecting the feed that has at the moment the best feed/price ratio and quality. Presently, for a 30% protein diet, the price is 2600 E£ per MT. As a rule of thumb, the feed price per MT goes up 100 E£/MT with each 1% increase in protein content. Fish feed producers named were 5 Stars, Hendrix, Skretting.

Fish culture practices:

- The total annual production is 200 MT of 350-500 g all-male tilapia. The fish is sold whole in Cairo.
- *Reproduction*: male and female brooders are maintained separately, until transfer to a 3 x 7 m spawning tank. 36 females and 12 males are stocked per tank. After 11 days the swim-up fry are collected by emptying the tank nearly completely. About 500-800 swim-up fry are produced per parent female. The fry are put on a 40% protein plus hormone diet for 3 weeks.
- *Nursing*: circular 1.4 m deep tanks are used, with a diameter of 5 m and a central drain and a slightly sloping self cleaning bottom. The tanks are treated with malachite green (methylene blue?), to kill all zooplankton, hence the only food source for the fry is the hormone diet. The fry are maintained in the circular tanks up to a weight of 50-80 g, before being transferred to grow-out tanks. At harvest, the biomass in the nursing/fingerling tanks is 35 kg/m^2.
- About 6 million swim-up fry are collected annually, and 3 000 000 fingerlings. Survival seems to be low, as about 600 000 market-size fishes are sold annually (200 MT annual production, assuming 3 fishes per kg).
- *Grow*-out: most of the grow-out tanks have a diameter of 11 (36 tanks) or 16 m (9 tanks) and are 1.4 -1.5 m deep. In an 11 m diameter tank, 6000 – 8000 fishes are stocked, where they grow to 350 – 500 g in 120 to 150 days. Each grow out tank (11 m diameter) has one 1.5 HP paddlewheel, operating between 7 p.m. and 11 a.m.
- Both for fingerling production and grow-out some race ways were constructed, but Mrs Mona considers these as less effective for cleaning than the circular tanks.
- Drainage pond: the water from all fish culture units drains in a 2000 m^2 pond, from where it is pumped and distributed through a sprinkler system in the crop production area.
- The ground water is 25^0 C, allowing to produce tilapia year round. Only reproduction stops during the winter months. During winter, most tanks are covered by plastic to conserve heat.
- The farms has sometimes a bacterial infection, and saprolegnia (fungus**)**, treatment is with antibiotics.
- Mrs Mona has contributed before to seminar/training course at WFC, and is willing to share her experiences in an EAgA seminar.

A biogas installation was built to process dead fish, chickens and organic wastes, but is presently not yet used. Gas will be used for cooking by laborers.

Photo 12. Mrs Mona, manager of Wataneya farm, at her desk

Photo 13. Paddlewheel in Wataneya farm

Photo 14. Raceways for grow-out, Wataneya farm

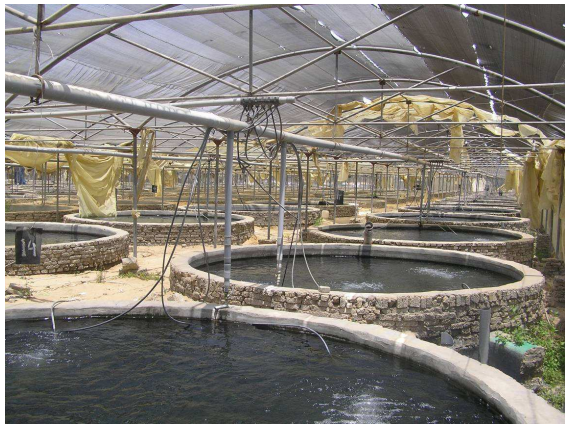

Photo 15. Concrete tanks for intensive grow—out of tilapia, Wataneya farm.

Photo 16. Crops at Wataneya farm, pigeon houses at the background.

24 May, 2009

University of Alexandria, Faculty of Agriculture:
Present: Prof. Dr. Adel. K. Soliman (Head of Department of Animal and Fish Production), Mrs. Nadia El Nokrachi and M. Verdegem

The Faculty of Agriculture was funded in 1942, and is the oldest agriculture faculty in Egypt. Prof. Soliman is a graduate from Stirling University (1981-1986), where he specialized in fish nutrition with Dr. Jauncy and Dr. Roberts.

In 2006, 613.000 metric tons of fish was produced in Egypt, of which 67.2 % is produced through capture fisheries (412000 MT) and 32.8 % through aquaculture (201,000 MT). (Other sources estimate the total fish production from farms much higher at approx 500,000 tons) Egypt avails over 6.4 million ha of water bodies, of which 86.7% are natural lakes, reservoirs and rivers. The remainder, 13.3% are dedicated to aquaculture.

Fish availability for consumption increased from 8.6 kg/caput in 1991 to 16.6 kg/caput in 2006. This is covered for 82.6% through local production. (Peter: this increase can not have come mainly from fish capture because the wild stocks are most likely already fully exploited). The rest is imported, and includes both luxury products and cheap marine fishes.

Within the Department of Animal and Fish Production one course 'Fish Production' is taught. The number of students enrolled in the course fluctuates between 15 and 30 from year to year. Prof. Soliman also teaches a course on Fish Biology in the Department of Food Technology. The Department of Food Technology has presently a cooperation running with universities in the UK.

Dr. Soliman did research on integration between Peking ducks and tilapia (published in Aquaculture international, see references). Through the increased nutrient input from duck manure the production increased 25% compared to traditional ponds without ducks. This research was done at an experimental station of the University of Alexandria which has 10 1-acre ponds for finfish culture, 8 shrimp ponds and a tilapia hatchery. The Faculty lack funds for maintenance and operation of this experimental station.

University of Alexandria, Faculty of Oceanography
Present: Prof. Dr. Abdel Fatah Mohamed El Sayed, Mrs. Nadia El Nokrachi and M. Verdegem.

Location: Faculty club

The majority of aquaculture production in Egypt comes from brackish water. A large fraction of the production comes from agricultural drainage water. The latter is a network of covered drainage pipes. The drainage water is rich in nutrients which contributes to the pond productivity. In this sense, water use for aquaculture in Egypt is not an issue for concern. Prof. El-Sayed thinks that direct freshwater use for aquaculture in Egypt is limited. This also means that integrated farming is also limited in Egypt.

EAgA is a farmers' association, where members pay a membership fee. The association represents its members but this does not include the majority of small farmers in Egypt. Most small farmers work on 1-2 (up to 5) ha plots which they subcontract from larger land holding leased from the government by middleman who have ± 100 ha concessions. The farmers pay 1000 – 2000 E£/acre/year. Water is free, and the cost of energy is very low.

Dr. El-Sayed published a FAO report in 2006, reviewing fish production systems in Egypt, and which includes the results of interviews with 39-42 farmers. See references list at the end of this report. The report can be downloaded: http://www.fao.org/docrep/011/a1444e/a1444e00.htm

There is a need to upgrade the quality of extension services in Egypt, as most of the staff are not proficient in Aquaculture. The set-up of the extension services in Egypt is that the agents are generalists, and lack a specific aquaculture training.

For integration with agriculture, Dr. El-Sayed mentioned 2 options:

- Desert aquaculture: these are large scale operations
- Farms with agricultural waste water: can do integration with rice, cotton, corn, wheat or other agricultural crops. Recently, WF did an experiment, but data were lacking on nutrient budgets.

May 26, 2009

Suez Canal University, Faculty of Environmental and Agricultural Sciences

Present: Dr. Samir (Dean, Faculty of Environmental and Agricultural Sciences) Dr. Ashraf Y. El-Dakar (Associated Professor of Mariculture, Fish Resources & Aquaculture Department, same Faculty), M.Verdegem & H. vd Beek.

Location: El Arish

Photo 17. From left to right: Dr. Samir, Dr. Verdegem, Dr. van der Beek and Dr. Ashraf Y. El-Dakar.

The Construction of Suez Canal University in Al Arish started in 1986. The main seat of the university is in Ismailia. The first students started in 1988, and the first graduates left in 1992.

Suez Canal University applies a 'problem oriented learning' approach, with permission from the government. Students get a problem assigned and learn how to define, analyze and solve a problem. This includes working with stakeholders, learning, and communicating, if necessary in a multidisciplinary environment. Each student works out the problem individually, then put the results from 10 individual projects together and summarizes them, and finally, puts all reports together and comes up with a common solution. The end result is a 'final combined report' with 'recommendations', which needs to be communicated to:

- extension services, and
- policy makers

The BSc students have a 4 year curriculum. Students are trained to work:

- on their own project
- for a company
- in extension
- in teaching, and
- in research

During their study, the students are trained in each of the above tasks.

Within the Faculty of Environmental & Agricultural Sciences, there are 7 departments:

- Fish & Fish Resources
- Soil & Water
- Animal Production and Protection
- Plant Production and Protection
- Feed Technology
- Economy and Extension Service
- Environmental Sciences

Dr. Samir follows up each graduate: so far, each one of them got a job.
Not only professors teach, also people with practical knowledge (for instances, an illiterate Bedouin can explain Bedouin law).

The Faculty of Agriculture of Suez Canal University supports agricultural development in Sinai. In 1988, 30000 acres were cultured, today there are > 330 000 acres are agriculture land. Nevertheless, graduates work all over Egypt.

Dr Samir is especially interested in the Bedouin that live in Middle Sinai, on the border with Israel. About 35000 Bedouin live in that area, mainly keeping goats and sheep, and they have little or no income. There are no jobs in the area. Smuggling by Bedouins is presently a problem in the region. The government likes the Bedouin to settle, but then should be able to provide them with a reliable income. Hence, it's considered a political and economic problem. Teaching these people to set up integrated farming systems, conserving water and energy costs, could be a solution. Dr. Samir mentioned *Aloe vera* (a type of Aloe) as a plant requiring little water, and a minimal labor input. It would be interesting to find out if fish/shrimp and *Aloe vera* integrated culture is an option. Working with the Bedouin in Middle Sinai, is also a priority for the Governor.

In the area around Port Said, there are ± 27000 ha of extensive coastal ponds. Dr. Samir likes to concentrate on marine aquaculture, this could be done in two steps: (1) establish a marine hatchery and (2) help in distributing small grants.

The faculty receives/received quite some grants from both international donors and local donations (e.g. percentage of fee for drivers license), the latter with strong endorsement from the local population.

<u>Research & training facilities</u>
The Fish Resources and Aquaculture Department has (1) a small recirculation system with tilapia (fresh water) and (2) a coastal research station.

1. Consists of (a) one fish tank, (b) a sedimentation tank, (c) a biological filter and (d) an overflow pond for catfish (*Clarias gariepinus*). The settling tank and biological filter are not functional.
2. The coastal research station includes:

a. A modular shrimp production system (partially copied from prof. van Wijk, Harbour Branch, US). Each rearing unit has a nursery tank, an inter-medium tank and a grow-out tank (surface ratio 1/3/9), connected to a sedimentation tank and submerged biofilter unit. Again the filters are not functional, and the culture densities are very low. The tanks are rectangular, and a circular flow around a plastic held on a frame in the middle of the tank is created by dividing and directing the water flowing into the tank.
   The PhD student working on this modular system (Salah Sakr) was not well informed. He needs more information on the culture of *P. semisulcatus*.
b. A shrimp hatchery, with life feed room (algae, rotifers and artemia), brood-stock maturation tanks, spawning tanks and larval rearing tanks.
c. Two 1000-m^2 outdoor ponds, liner on the bottom, with red tilapia.
d. A tilapia hatchery (for red but also normal colored tilapia)
e. Water sources include a deep well pump delivering 40-60 m^3/hr and a seawater line pumping ± 20 m^3/hr. The seawater is used in the hatchery, after passing through an UV filter.

Photo 17. Tanks available for reproduction and brood stock maintenance at Suez Canal University

At present, 13 BSc, 8-9 MSc and 4 PhD students are linked to the Fish Resources and Aquaculture Department. There are two lecturers specialized in Aquaculture who provide courses in (a) nutrition of fish and shrimp, (b) fisheries, (c) genetics and (d) reproduction.

Farm of Mrs Marya, Salem

A small farm of Mrs. Maryam Salem was visited. The total farm size is 2 acres. Groundwater for irrigation is available (but not controlled), a 2 m deep 3 x 12 m tank and small plots with vegetables and a coral with goats. The fish tank could be used for African catfish production (at present tilapias are in the tank, and the farmer was feeding them with grass, which is not very effective). Each week, one day in the week, the tank is nearly completely drained for irrigation. The suggestion was made to culture African catfish (*Clarias gariepinu*s) in the tank.

5. MAJOR FINDINGS AND CONCLUSIONS

1. Status of integrated fish farming in Egypt.

A variety of integrated systems is already used in Egypt, but the cases are few and often far apart (spread out over a large area). We saw mostly integration within one large farm. The following forms of integration were observed or reported to be practiced on the farms we visited:

	Chicken manure	**Use of pond water for irrigation of trees, crops**	**Wheat culture on pond bottom**	**Rice culture on pond bottom**	**Rice fields**	**Goat & sheep manure**	
Tilapia farming in ponds	YES	French Group,	WFC	WFC			
Intensive tilapia farming		Wataneya Farm; Mrs Marya's farms					
Growing carps for home consumption					Carp fry stocked in 120000 ha rice fields		
Tilapia farming in recirculation systems		Hope of Dr Ismail Radwan (not yet reality)					
Tilapia waste water drained in catfish pond		KERAM farm: alfa-alfa fields to feed goat, sheep				KERAM: sheep manure to biogas digester	

Key informants spoke about small-scale aquaponics, stocking of carp as a side crop in rice culture, and the use of catfish pond drainage water to raise alfa-alfa (goat feed) followed by the use of goat manure for biogas production at KERAM farm, but we were not able to observe such forms of integration ourselves.

JICA is said to support small-scale aquaponics projects for schools etc. Aquaponics = growing vegetables on a substrate using water from tanks with fish as source of water + fertilizer. Numbers, status, type of integration and results etc are not known and need to be looked into.

The use of chicken manure is common in pond farming by large-scale commercial farms but at present its use is limited due to restrictions to move manure, limited manure availability, etc as result of avian flue. One resource person mentioned a reduced use also as a result of intensification of pond farming (which depends on complete feeds). The use of large amounts of manure was believed to compromise water quality, but research done at Alexandria University comparing fish production from ponds with duck manure fertilization with fish production in ponds without such fertilization showed higher production from fertilized ponds. There seems to be no cultural objections against the consumption of fish from ponds that received (chicken) manure. Some consumers prefer fish caught from natural waters over farmed fish.

At (very) small / traditional farmer level there seems to be no tradition of integrated aquaculture/agriculture systems (i.e. a tradition where almost every farmer has also a small pond, applying manure, etc like seen in some Asian countries). The most commonly applied form of integration in Egypt seems to be rice-fish (carp) culture, followed by the use of (chicken) manure in ponds. Rice-fish farming in Egypt is based on free carp fingerling distribution by the Government (Ministry of Agriculture) and success in terms of kg fish/ha produced is limited and varies per district/region. The fish harvested from rice fields is for home consumption; there is no market for small carps for consumption. We heard skeptic reports about this program, and this reputation may affect people's perception about integrated fish farming.

2. The present and future availability of water

The government of Egypt is concerned with conserving good quality fresh water resources but we did not get the impression that present or future limits to the use of water was a major concern on most of the farms we visited. Water was always available (from wells or irrigation canals) at low or no cost at all. Electricity costs for pumping water were considered low. Only Dr Radwan was concerned with conserving water for the future, hence his testing of a recirculation system. The owner of one farm who did not use the fish pond water for irrigation offered to pump the drainage water from ponds back to the irrigation channel to demonstrate his concern for conserving fresh water. (There may be regulations from the Ministry of Irrigation preventing this. This remains to be checked.)

Payment for the use of well or irrigation water is not linked to the amount used so nobody seems to measure or record the amounts of water pumped (exception: for research purposes by WorldFish Center). There is an annual charge for irrigation water related to the size of the farm. On the farms there seem to be no detailed data on the amount of water being used, or on the amounts of water leaving the farms as drain water. Due to the low cost of electricity water seems to be pumped from wells and from canals in great amounts.

3. Environmental concerns

The Ministry of Environment believes that fish farming causes pollution. This led to complete cages removal from a section of the Nile some years ago. EAgA has proposed a well monitored cage farming trial to determine the nature and extend of pollution by cage farming, but no definite approval was obtained yet.

4. Legal and institutional obstacles

Some Government of Egypt regulations that are aimed at conserving fresh (irrigation) water and fertile agricultural land complicate a further integration of aquaculture in agriculture:

- exclusion of fish farming from the first use of irrigation water (but in Kafr Al-sheiks region the use of fresh irrigation water for tilapia farming is taking place. Such practice has reduced soil salinity in farms and made land suitable for agriculture!
- on black soils the conversion of land use from agriculture to aquaculture is forbidden.
- once land has proven to be suitable for agriculture it can not be used for aquaculture.
- in addition the present restrictions on use and movement of chicken manure (related to Avian Flue) make manure less available.

The objectives of one ministry may be frustrated by regulations originating from another ministry. There seems to be a need for dialogue between ministries and departments involved or concerned with (integrated) aquaculture aimed at removal of such juridical constraints.

5. Education and extension

The cooperation between higher education institutes, scientists and the private sector could be improved. We learned that the trust of farmers in government staff, in scientists and fresh university graduates is low.

Higher education on aquaculture is often theoretical in nature (but far less so at Suez Canal University) and fresh graduates are poorly equipped to start work in a highly practical fish farm setting.

There is a demand for well-trained fish farm technicians and managers. Additional vocational training in fish farming with a strong practical component is needed. Fortunately the WFC, CLAR, the training centre of Dr Radwan, EgAA and others are already undertaking action on this subject.

6. Subjects and issues that remain to be looked into as part of this BOCI study in 2009:

- the nature of NL-Egypt collaboration program on water (Nile Basin Initiative); is saving water by means of integrated aquaculture-agriculture an issue and has it been looked into before? Is it a topic this program is interested in and are funds for further research and testing available?
- water needs and salinity tolerance of common Egyptian crops
- better data on water use in (fish) farms.
- status of aquaponics project that is supported by JICA.
- possibility for integrated aquaculture at site of Bedouins in Central Sinai Area as mentioned in the brief proposal by Dr Samir Ghoneim "Integrated Farming to Develop Middle of Sinai**"**.

7. Seminar/workshop

A follow-up seminar or workshop in 2009 could discuss**:**

- presentation of various integrated and intensive aquaculture systems by the Egyptian farmers that use these systems. In workshops, participants can be asked to compute/estimate and present certain key figures that allow comparison between systems;
- presentation of forms of integrated farming practiced elsewhere in the world;
- presentation of estimates of water reduction as result of different forms of integration (if figures are available), and ratios of amount of fish farm waste water needed in relation to need of certain crops (water saving and reduction of fertilizer needs)
- possible pilot projects: small-scale intensive fish farming in combination with agriculture (water from fish farm used in agriculture) with better monitoring of amounts of water used in a year and to determine the amount of fertilizer saved (quantity and financial saving). More than one pilot may be needed to be able to compare the integration in various soil and water conditions: black soil versus dessert; fresh versus brackish ground water; marine conditions.

Besides from farmers, scientists and concerned government officials also staff involved in agricultural extension should be invited to this seminar to make them familiar with the advantages of integration of agriculture and aquaculture.

8. Suggestions for BOCI 2010

- To convince the water authorities and farmers on the advantages of integrated fish farming hard data on the exact amount of water and fertilizer being saved per kg of product may be needed. It is therefore recommended to develop a pilot project that is an integration of intensive fish farming and the use of fish farm effluent for crop culture. In such a pilot project water consumption and water drainage should be monitored (quantity and quality) to come to estimates of possible production (fish + crop, kg) per m^3 water. Also an estimate of the amount of fertilizer saved should be obtained, to support economic & environmental argument for integrated systems. Besides from expertise from the Netherlands such a project should involve a local scientific research institute who can do local monitoring, collect and analyze samples and data and do follow-up on the implementation. Ideally the data on water use and effluent (waste water) should be obtained in various agro-ecological settings (Black soil vs desert, fresh water vs brackish water).
- An Egypt-based institute or researcher could be commissioned to make a map of all ministries and departments concerned with integrated fish farming including identification of the key persons, identification of the juridical and institutional obstacles on the way of various forms of integrated (fish) farming, and the organization of a workshop of key persons in the departments involved to

develop mutual understanding of each other's objectives and arguments and to design a strategy on how to remove these obstacles. This should be coordinated with the Netherlands supported Nile Basin Initiative.

- Development of project proposal aimed at support to integrated development in the Central Sinai area with Bedouin communities. The project will require a visit (mission) that will study the situation on-site and discussions with local government staff, staff of technical agencies, interested University staff and local Bedouin leaders. Agricultural, fish farming and institutional development aspects will have to be taken into consideration. Funds from the BOCI program can be used to visit the site, hold workshops with stake holders and develop the project proposal in a participatory way. The proposal will be submitted for financing from an international donor agency, possibly the European Commission.

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ANNEX 1. Itinerary

Date	Time	Activity	Meeting with	Accompanied by	Transport
16-May	3:00 AM	Arrival KL 553 P. vd Heijden			Gamal (Embassy)
	11:00 AM	French Group	Mr Jamel, Mr Shawky	Eng. Sherif Rashed	EFC car
17-May	7:00 AM	World Fish Center	Dr. M. Beveridge, Dr Ahmed Rahman	Mrs. Dina Hamdy	EFC car
	9:20 PM	Arrival MS 758 M. Verdegem			Gamal (Embassy)
18-May	7:00 AM	Ragab farm - Nubareya	Dr Ismail Radwam	Eng. Sherif Rashed	EFC car
19-May	7:00 AM	Aquaculture Training Center	Dr. Ismail Radwan	Mrs. Dina Hamdy	EFC car
20-May	9:00 AM	Meeting at Embassy			Gamal (Embassy)
	9:30 AM	Rabo Bank - Horus Food & Agribusiness Fund	Frits Monking		
	11:30 AM	Ain Shams University	Prof. Amin El-Gamal	H. van der Beek; Mrs. Dina Hamdy	Gamal (Embassy)
	2:00 PM	Dir. Gen. Agriculture	Prof. Dr. Mohamed Fathy Osman	H. van der Beek; Mrs. Dina Hamdy	Gamal (Embassy)
	5:00 PM	Lunch	Prof. Dr. Mohamed Fathy Osman	Mrs. Dina Hamdy	EFC car
	7:30 PM		Dr. M. Beveridge		
21-May	8:00 AM	Wataneya farm	Eng. (Ceim) Mona	Mrs. Dina Hamdy	EFC car
	5:00 PM	Lunch		Mrs. Dina Hamdy	EFC car
	8:00 PM		Mr Ahmed Nasr Alla, World Fish Centre		
22-May	9:00 AM	Reporting			
23-May	4:00 AM	Departure KL 554 P. vd Heijden			
	9:00 AM	Reporting			
24-May	7:00 AM	Train Alexandria			
	11:00 AM	Faculty Agriculture - Alexandria University	Prof. Dr. Adel K. Soliman	Mrs. Nadia El Nokrachi	
	1:00 PM	Oceanography Department - Alexandria University	Prof. Dr. Abdel Fattah El Sayed	Mrs. Nadia El Nokrachi	
25-May	whole day	Reading Egypt Fisheries country reports, Mission report writing		Mrs. Nadia El Nokrachi	
26-May	6:00:00	El Arish; Suez Canal University	Dr Samir. Dr. Ashraf Y. El-Dalkar	Mr. Hassan Nashaat; H. van der Beek	EFC car
	1:00 PM				
27-May	10:45 AM	Departure MS 757 M. Verdegem			Gamal (Embassy)