Report of the

# Workshop on integrating fish farming in agriculture – present situation, future possibilities in Egypt

Venue: J.W. Marriot Hotel, Cairo, Egypt
Date : 13 December 2009

Under the auspices of the Minister of Agriculture & Land Reclamation, H.E. Amin Abaza, this Workshop was organised by Wageningen University & Research Centre (The Netherlands) and the Egyptian Fish Council (EFC) under the Egyptian Agribusiness Association (EAGA), in co-operation with and the Embassy of the Kingdom of the Netherlands in Cairo. The Workshop was an output of BOCI project nr BO-10-006-111 "Integrated aquaculture Egypt", financed by the Ministry of Agriculture, Nature & Food Quality in the Netherlands.
The objective of the Workshop was to present current practices of integrated aquaculture in Egypt, as well as examples of integrated practices worldwide, and discuss opportunities for development of the sector and tackling bottlenecks. At the workshop, a high ranking representation from the Ministry of Water Resources & Irrigation was present, allowing a vivid discussion with the fish farming sector on restrictions. These discussions are regarded as valuable and a first step in a dialogue between the Ministries of Water and of Agriculture with the private sector, to develop the sector in a sustainable way. It is clear that the challenge lies in an efficient use of ever restricted water resources in Egypt for a higher agricultural output, including farmed fish.
There were approximately 90 participants, mainly from the private sector and organisations cq institutions related to fish farming. Also from the Ministries of Agriculture & Land Reclamation, and of Water Resources & Irrigation, participants were present.

## **INTRODUCTIONS**:

The workshop was opened by **Eng. Sherif Rashed**, chairman of the Egyptian Fish Council and chairman of this workshop. Mr Rashed pointed out that the freshwater supply is a critical issue for Egypt. With support from the Netherlands Embassy the EAGA has acted on this issue already in the past, among other things by sending members to training courses and study tours about fish farming in recirculation systems, and with financial support to the Dr. Ismail Radwan, who has established a fish farm unit with recirculation system. The present workshop is proof of the concern of EAGA and the Netherlands Embassy for the water issue in Egypt.

*Opening of the workshop. From left to right Eng. Sherif Rashed (Egyptian Fish Council), Dr Hussein Elwan (advisor to the Min. of WR&I), Dr. Mohamed Fathy Osman (Min. of Agric & LR), Dr Osama Kheir Edin (Chairman EAGA) and Dr. Hans van der Beek (Netherlands Embassy).*

The Agricultural Counsellor of the Netherlands Embassy, **Dr Hans van der Beek**, pointed at the great importance of fish and fish farming for the overall Egyptian fish and animal protein supply and food security. The Egyptian fish farming sector has expended rapidly in the past decade and has now reached a production of nearly 600,000 tons, representing more than 60% of the total fish production. Fish farming will likely grow further due to high demands of animal proteins from an ever increasing population, and due to the limits on further expansion of sea fishing. However, certain regulations restrict the development of fish farming to its full potential. The use of irrigation water for fish farming is not allowed; the law allows fish farmers only the use of drainage and ground water. In 2007 floating cages, popular for Tilapia production, have been removed from a branch of the Nile river in an attempt to reduce water pollution. The short lease period of public land for fish farming is also restricting further development, and this does not encourage investors. Recently, the Inter-Agency Assessment Mission presented recommendations on aquaculture, with a plea for new legislation on the lease of land and to revisit the ban on using fresh water for fish farming. The Netherlands contributes to the fish farming sector in Egypt for several years already through various projects.

**Dr Mohamed Fathy Osman**, Chairman of the General Authority of Fish Resources Development, Ministry of Agriculture and Land Reclamation, noted that fish has so far not played a role in the various animal diseases such as Avian influenza that have affected the Egyptian animal husbandry sector recently. He thanked the Netherlands and in particular Dr Hans van der Beek and his predecessor for their support to the Egyptian agriculture sector, and in particular the fish farming sector. Dr Fathy Osman pointed out that fish production needs to be increased to supply the Egyptian demand and for export purposes. On the other hand it is in today's context not possible to stop fish imports even if such imports pose serious

competition to Egyptian producers. Integration of fish farming in the existing or planned agriculture activities is not a luxury but a necessity. Ninety-five % of the Egyptian fish farming production takes place in fresh water. It was stated that fish farming does not consume water but only uses it, and that fish farming does not cause water pollution. Dr Fathy Osman also pointed out that Egypt used irrigation water to produce animal feed. Being fully aware that the freshwater resources of Egypt are limited and need to be used rationally, Dr Fathy Osman stressed that fish production per surface unit needs to grow. The target is 4 ton of fish/feddan of water (approx 9 ton/ha). Egyptian students and scholars were send to the USA and the Netherlands (among others) to learn: "seeing is believing". Dr Fathy Osman defended the use of irrigation water for fish farming, in combination with the use of water leaving the fish farms for irrigation of crops. Such a system would also enable the reduction of the use of fertiliser. The water that leaves fish ponds contains organic fertilizer that is more beneficial to the land than chemical fertilisers. Dr Fathy Osman reminded that fish farming has had a bad press in the past, but he argued that the health of fish is a reflection of what the fish has eaten. He called for a review of the water policies because allowing only the use of drainage water for fish farming is unhealthy: in many places drainage canals also receive domestic waste. Such a situation gives Egyptian farmed fish a bad reputation abroad, and is the cause of the EU not permitting the import of Egyptian farmed fish.

*A part of the audience of the workshop*

**Dr Hussein Elwan**, advisor of the Ministry of Water Resources & Irrigation, discussed the attempts of the MWRI to address the water challenges that Egypt is facing and will face in the future. A water-use plan, sponsored by the Netherlands, called 'How to face the challenges' has been written. The available quantity of fresh water/person is diminishing. In addition pollution threatens the quality of the freshwater resources that are available. The part of the water that falls in the Nile river catchment area and that ends up in the river is shared by the riparian countries that are situated in the Nile basin. At present, 84 billion $m^3$ water is available for Egypt. Quota per country have been agreed, and it is interesting to note that Sudan has not fully used its quotum so far, which left more water in the river for Egypt to be used. Contrary to Dr. Fathy Osman, Dr Elwan pointed out that fish does consume water, just like agriculture, industry and households do. And all these sectors have a growing

need/demand for water. There is no escape from re-using more drainage water before it is discharged into the sea. He also pointed out that the fish cages in the Damietta branch of the Nile were removed because they posed a threat to the drinking water supply. Dr Elwan said that aquaculture has caused damage to the drainage system (canals, pumps) and stressed his conviction that coordination by all water users is needed. This seminar is already a contribution to the coordination.

**PRESENTATIONS**

**Dr Osama Kheir Edin** (EAGA Chairman and owner of El Hoda Farm, Serapeum, Sinai), showed slides of **Al Hoda Organic Farm** and explained how the management of this farm uses the water storage basins as ponds for tilapia. The retention time of the water in these basins is on average one day before it is used for irrigation. In this way not much water is lost through evaporation. He mentioned that 30 to 40 $m^3$ of water is needed per feddan of crops. Keeping fish in the water storage basins enriched the water with organic fertiliser. Per $m^3$ of basin space 2.5 kg of fish is produced. Dr Kheir Edin recommended this system, hoped for further cooperation with Wageningen UR to calculate the efficiency and invited the audience to visit El Hoda farm to see the system. He ended with a reaction to the speech of Dr Elwan by calling for a cancelling of the fish farm permits that make use of polluted drainage water.

*Irrigation storage basin at Al Hoda Farm that is used as fish pond.*

From the audience came the remark that the Government should act more to control water pollution by reducing the input of pollution and by better treatment of waste water. Clean water is needed to produce healthy crops, poultry and fish for a growing Egyptian population. Fish farms should also be allowed to use irrigation water. It has been demonstrated that fish farming does not pollute water, it only fertilises it.

**Dr Marc Verdegem** (Wageningen University, Aquaculture & Fisheries Group) explained the principles of integrated fish production, showed some examples and sketched possibilities for

aquaculture growth on a global scale. At present global aquaculture is estimated to use 429 $km^3$ of water /year, which equals 16.9 $m^3$ of water / kg fish. In comparison, agriculture uses approximately 3800 $km^3$/year for irrigation. A doubling of global aquaculture production with present methods is not possible because there is

- Not enough fresh water
- Not enough space/land
- Not enough nutrients/fertilizer

The available stretches of suitable land and water already limit further expansion in many locations. For further growth of aquaculture it is necessary to

- Develop Marine Aquaculture
- Increase water productivity (= more fish produced per $m^3$ of water used)
- Improve nutrient cycling and reuse through integrated systems:
    - Crop - animal – fish systems
    - Multi-trophic Integrated Aquaculture Systems

*Dr. Marc Verdegem, Wageningen University*

The use of animal manure in fish ponds is not a very efficient way of using the nutrients: only 5 to 10% of nitrogen and 5% of phosphorous input is retained in fish biomass. The basic biological processes that convert manure to fish allow only a maximum theoretical efficiency of 30% because loss takes place in each step of the food chain.
Using organic wastes to grow algae is a more efficient way, but one major limitation to increase micro-algae production is the expensive methods to extract microalgae from water (cost up to € 20/kg dry algae). It has been tried to grow algae-eating fish on microalgae, by connecting the algae-producing tank with the ponds or tanks in which fish are kept, but such systems are not easy to manage because of the highly varying dissolved oxygen content of the water in the algae tank. The increased production and use of macro-algae is also limited due to a limited demand for the phytoplanktivore fish species like silver carp outside Asia.

Multi-trophic integrated systems (combining aquatic plants and animals): The complete use of the waste produced by fish kept in cages in salt or fresh water by means of extractive species such as shellfish and algae is a challenge because of finding and maintaining the optimum ratio between feed input and the quantity of the extractive organisms to be kept.
Artificial wetlands have shown to be a very efficient, robust and easy way to process organic wastes and minerals found in domestic and industrial wastes, and have also been successfully

applied to treat concentrated fish farms effluents. Wetlands can remove 50% of Nitrogen and Phosphorous and 100% of the total solids.
Using agricultural crops to remove nutrients from water enriched by fish kept in recirculation systems has been developed and tried in many locations, but only in a limited number of contexts such integrated farms have proven to be economically profitable and sustainable.


*Slide form presentation of Dr Verdegem, showing tilapia and vegetable culture combined in one recirculation system.*

Dr Verdegem concluded that there are many different types of integration possible; a total of 9 different types were presented. However, integrated systems have biological limitations to their efficiency. The waste produced by fish farms is an incomplete fertilizer. Despite of these limitations integration is still the way forward for increased aquaculture production because it is (1) more water and (2) more nutrient efficient, and (3) it complies with the wish of the public to make farming sustainable, guaranteeing future consumer acceptance.

After the coffee break, **Dr Hussien Elwan** was given the chance to explain his remark that fish uses water. He explained that fish farming uses water as result of the evaporation taking place in ponds. Egypt has an average evaporation of 2500 mm/year. As a consequence, rice growing uses a lot of water as does sugar cane (estimated use 9000 and 12000 $m^3$/feddan/year, respectively). Fish farming is therefore also a water user, mostly as result of this evaporation. The real issue is how to use the available water in Egypt in the most efficient, integrated way. An example of reuse is found in Israel, where treated sewage water is used to irrigate fruits.

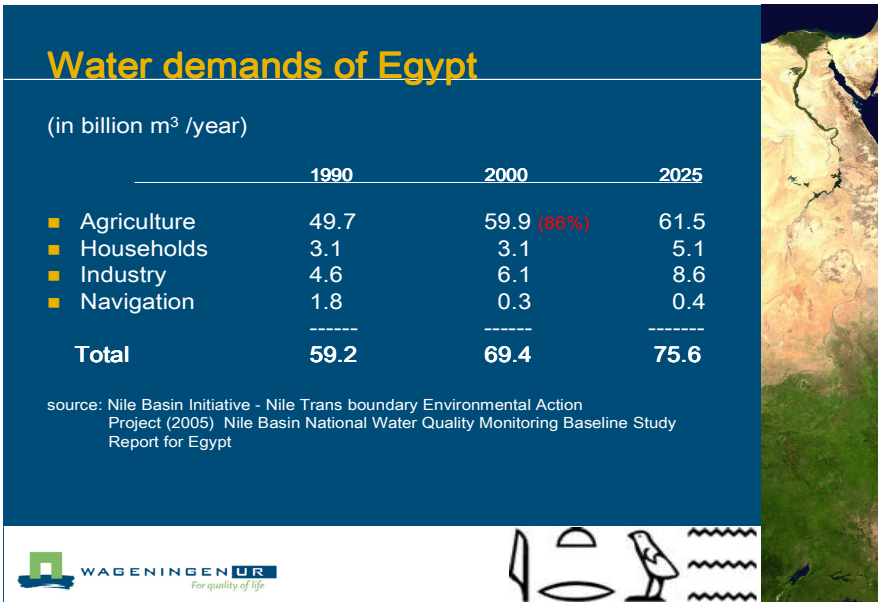
The fish-farming audience reacted dynamically to Dr Elwan's explanation with the following arguments and questions:
- Fish farming does not take 12 months but only approx. 7 months per production cycle.
- Who is responsible for the treatment of waste water? This is obviously important as at present 80% of the fish farms are depending on drainage water.
- Why is fish farming banned from first use of irrigation water, and not the other big users such as rice and sugar cane growers? If the government condemns fish farming to the use of drainage water only it contributes to endangering the health of the Egyptian consumer

because of the heavy metals and other poisonous elements such drainage water may contain. Egypt is the only country in the world that does not allow fish farmers to use irrigation water. - National security is depending on water security. However, sufficient and healthy animal protein is also a factor in national security.

Dr Elwan responded by pointing out that the MWRI is not the cause of pollution, rather the victim. Indeed, water recirculation (re-use) is badly needed in Egypt. At present 75% of the irrigation water (45 billion $m^3$ of 59.9 billion $m^3$) ends up in the drainage canal and should be treated for reuse. He stressed again that the limited fresh water supply of the country urges for a better coordination between the various users. Finally he added that the legislation banning the use of fresh water for fish farming came from a time of low industrial activities.

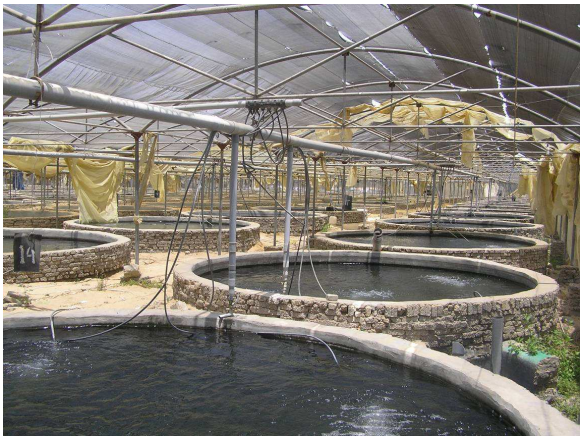
Dr Verdegem pointed out that fish farming can be considered as a form of agriculture, and deserves a portion of the irrigation water just likes crops do. Egypt should evaluate its situation: should the country respond to the growing demand for fish by increasing production or by importing more fish? When water use is evaluated by comparing the value added by each type of water use (by different crops) it will probably become clear that farming fish adds good economic value per $m^3$ of water used in comparison to other more established water uses.

**Mr Peter G.M. van der Heijden** (Centre for Development Innovation, Wageningen UR,) sketched first the present and future freshwater supplies and demands of Egypt. In two tables with data extracted from the Nile Basin National Water Quality Monitoring Baseline Study it was shown that the total water supply is approx 71.7 billion $m^3$ in 2000 and is not expected to increase. The demand however was already 69.4 billion $m^3$ in 2000 and is expected to be 75.6 billion $m^3$ in 2025**.** Agriculture is responsible for 86% of the demand. Next van der Heijden described the brief inventory of existing integrated fish farming activities that had been undertaken in May 2009 by Dr Verdegem and himself. Research institutions, farms and universities were visited. Some of the institutes and farms are in today's workshop program to present their involvement in integrated fish farming.



*Slide from presentation by Mr. van der Heijden*

**Mrs Mona Ceilim**, the manager of Wataney farm (one of the farms that were visited in May) was invited to explain her experiences with integrated farming. At Wataneya farm the water coming from an intensive tilapia production unit supplied with underground water is used for the irrigation of crops and fruits.




*Intensive tilapia culture under plastic cover and out-doors at Wataneya farm*

Upon request, also Mr Ahmed Mounir, board member of Keram International, explained the experiences of Keram farm with the use of waste water from tilapia and catfish farming to grow alfalfa. The latter crop is used to feed sheep and goats. There were many questions from the audience to Mrs Celeim and Mr Mounir.

Referring to the observation by Dr Verdegem that the techniques needed to extract micro algae are very costly Mr van der Heijden pointed at duckweed (*Lemna spp*) as an alternative for micro-algae. Duck weed is a very fast growing weed that flows on the water surface and is very easy to harvest. Duckweed adsorbs ammonia and phosphorous from waste water and converts it to a protein-rich plant tissues. It can be fed directly (fresh) to tilapia, chickens and ducks. In dried form it is also an excellent and protein-rich component of fish and other animal feeds. Because of the danger of chemical accumulation care should be taken that the waste water used to grow duck weed does not contain poisonous / harmful chemicals.

*Questions from the audience to the presenters*

**Dr Ismail Radwan** (Egyptian Aquaculture Centre) presented the first experiences with the recirculation system that he built in 2009 and reported the result of the first harvest. The

recirculation system had been made possible with a donation of 2 pumps and a generator by the Netherlands. The production from the fish tanks had been 41.6 kg of tilapia /$m^3$ of basin in 100 growing days. Water replacements was high: 30%/day, but this was also because the fish tanks have flat bottoms and the system has no proper solids waste remover. Therefore the fish tanks have to be drained and cleaned every few days, and this takes more water than would be the case if the system had a proper solid particle remover. Dr Radwan estimated that the water use of this system during its first trial run was 1 $m^3$ / kg fish produced.


*Self-made trickling filter and detail of filter material in recirculation system at the farm of Dr Radwan*

**Dr Alaa Badr** (Hendrix Misr) presented the benefits of using a high-quality complete fish feed. Dr Alla sketched the history of tilapia feeding in Egypt, which started with poultry farm wastes & litter, rice or wheat bran, followed by mashed feeds, next was pressed pelleted feeds and the latest innovation in the development in fish feed technology is extruded feed. Such a feed can be better digested by the fish than pressed feed pellets, resulting in a lower feed conversion ratio (1.2 versus 1.8 to 2.0 kg of feed per kg weight gain). Mr Alla Badr also pointed out that the protein and fat content are not the only important quality parameters for fish feed. The right amino acid balance and the correct fatty acid balance are equally important parameters. Modern fish feed companies such as Hendrix Misr also offer feeds that prepare the fish for breeding or for stressful conditions such as the cold season.

**Mr Ahmed Nasr-Allah** (WorldFish Center, Abbassa) presented the result of research done by the WFC addressing the following critical questions:

- is aquaculture a good use of water?
  - how much water does aquaculture use?
  - how do we measure impacts of water use on human well-being?
  - can simple water accounting methods be developed for use by communities and policy makers to guide water allocation decisions?

- are there aquaculture technologies that make better use of water?
  - how does implementation of such technologies impact on poverty?

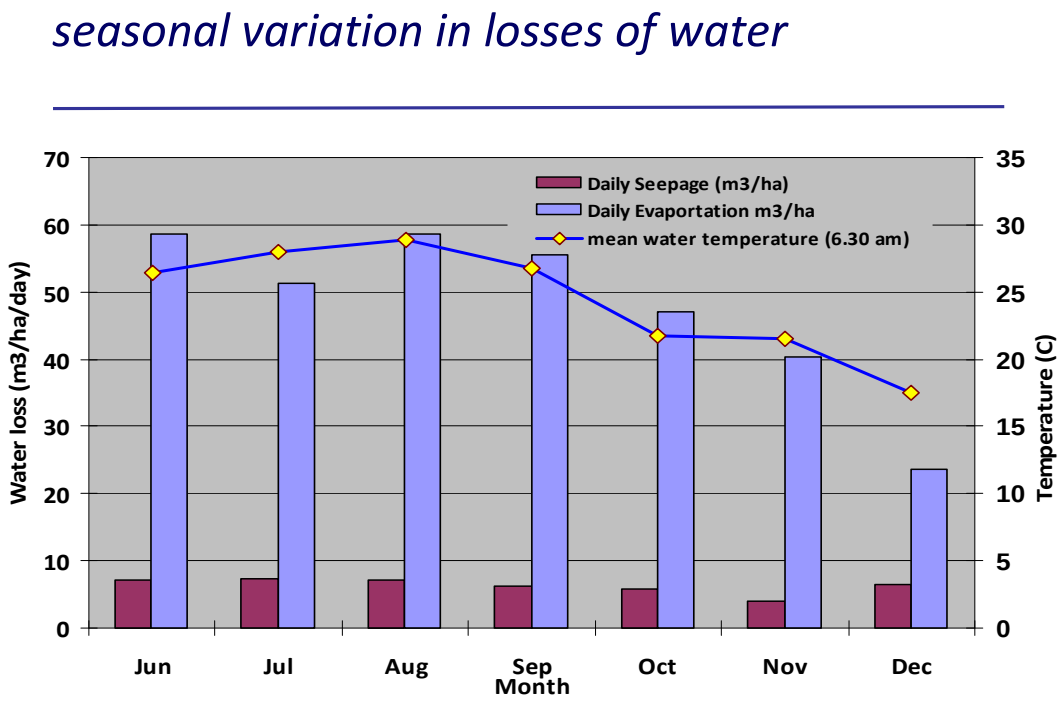
Drawing form the Comprehensive Assessment of Water Management in Agriculture Mr Nasr-Allah showed that the benefits of aquaculture vary wildly, depending on the type of system used and on the productivity. Production per $m^3$ of water varied from 0.05 to 1 kg of fish; economic benefits generated by fish farming varied from 7 cents to $ 1.35 per $m^3$ of water used.

WorldFish Center conducted research at the Centre in Abbassa and on a site in Kafr El Sheikh in order to establish water consumption and water loss by fish farming. The average water loss at the 2 sites was 50 $m^3$ of water/ha/day, of which 93% was lost due to evaporation. The water productivity at the Abbassa site (where more extensive fish production took place) was 3.6 $m^3$ of water/kg fish, while at the Kafr El Sheikh site (higher fish production) the water

productivity was 1.12 $m^3$/kg fish. In comparison: various agricultural crops have a water productivity ranging from 0.74 to 2.9 $m^3$ water per kg product produced. However, fish production results on average in more money per $m^3$ of water used than most agricultural products except for certain fruits. Average profitability in this study was $ 0.31 per $m^3$ of water.

The preliminary results of research on integrated fish + crops systems (rice and fish grown in ponds at the same time, wheat grown in winter on the pond bottom after the fish harvest) show a very good fish growth in the ponds that were used for wheat production. The average water consumption of the ponds with rice was 2.99 $m^3$/kg. When wheat was grown after the fish harvest the water efficiency of the system increased remarkably because the extra wheat crop (5400 kg/ha) was possible without much extra water input.

At the end of his presentation Mr Nasr-Allah listed the juridical obstacles that limited the use of fish-crop integrated systems in Egypt.
There was no time for responding to questions from the audience in a plenary session, and the chairman of the workshop referred to the lunch as an opportunity to have questions answered.




*Slide from presentation of Mr Ahmed Nasr-Alla, showing evaporation and seepage rates of fish ponds in Egypt*

## CONCLUSIONS

At the end of the workshop Mr. van der Heijden said that this workshop had stressed again the challenges that Egypt faces in terms of water availability in the near future, but it has also shown the possibilities that exist to use the available water more efficiently by means of integration and recirculation. The presentations of various Egyptian and foreign experiences with integrated fish farming and the research results show what is possible in terms of more efficient use of water. There are however juridical and institutional obstacles that limit a further application of integrated aquaculture systems. Some of these obstacles are based on

assumptions that are outdated and may have to be revised when more data and information would become available. Considering fish farming as a form of agriculture would remove one of the obstacles , namely the law that prohibits the use of fresh irrigation water for fish farming. The Netherlands Embassy and Wageningen-UR are planning to continue their support to more efficient water use by means of integrated fish farming and water recirculation in 2010, for instance by giving support to on-farm trials. Such trials are expected to result in data that will help to quantify the water and fertilizer savings that result from the integration of fish farming in agriculture.