Centre for Development Innovation

Integrated aquaculture - agriculture in Egypt

Towards more efficient use of water resources

Peter G.M. van der Heijden

Workshop Report

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Project (BO-10-011-102), National strategy on efficient use of fresh water by application of integrated aquaculture

This research project has been carried out within the Policy Supporting Research for the Ministry of Economic Affairs, Agriculture and Innovation, theme: Scarcity and distribution, cluster: International Cooperation.

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Van der Heijden, P.G.M.

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Centre for Development Innovation, Wageningen University & Research centre

Results of recent studies, research and practical experiences from Egypt and abroad with forms of aquaculture that use water en nutrients more efficiently than common pond culture were discussed at a workshop held in Cairo (April 21, 2011). The presentations include the results of a study undertaken on four Egyptian integrated aquaculture – agriculture farms where water use, effluent water quality, fish harvest and revenue from crop and fish sales in 2010 were monitored.

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Executive summary

This report summarizes the presentations, discussions and recommendations of a workshop held April 21, 2011 in Cairo. During the workshop the results of the Policy Support project BO-10-011-102 of Cluster International called 'National strategy on efficient use of freshwater by application of integrated aquaculture, Egypt' were presented. This projected consisted of:

- A study on juridical and institutional challenges to integrated aquaculture in Egypt. The study was contracted to Synergie and resulted in an overview of the most important laws and regulations regarding water and land use that affect a wider application of integrated aquaculture – agriculture systems in Egypt. The important laws originate from the 1980's and aim to conserve Egypt's limited freshwater resources and agricultural land. Except for hatcheries these laws exempt fish farms from the use of irrigation (Nile) water.
- During an earlier BO project that dealt with integrated aquaculture in Egypt it had become clear that a lack of hard data on the quantities of water used by (integrated) fish farms hampered discussions about the use of fresh water by fish farms. To reduce this lack of data BO-10-011-102 included a study contracted to WorldFish Center that looked into the quantities of water used and the effect of integration on water quality at four integrated aquaculture – agriculture commercial farms. Two of the farms used fresh ground water for tilapia farming; the water coming from the fish basins was used to irrigate crops and fruit trees. For these farms the sales of fish was the main source of income. They used 2.7 – 3.1 m^3 of water per kg of fish produced, and gross farm revenue was LE 3.61 and LE 3.76 per m^3 of water used. The other two farms used water derived from irrigation canals; to bridge days when no irrigation water was available water was stored in reservoirs in which tilapia was stocked. For these farms the sales of fruits and other crops was the major source of income. The gross revenue of these farms was LE 2.36 and LE 2.46.

Besides from the results of these two components of BO-10-011-102 the results of research undertaken in 2008-2009 on water use in fish ponds and in various integrated aquaculture systems were presented by staff members of the WorldFish Center. Other guest speakers presented methods to reduce water use that are applied in other countries and the results of the first commercial Egyptian farm that applies water recirculation for tilapia culture. The experiences of a farm growing marine fish on salty groundwater in the desert were also shared. At the end the major results and recommendations of the workshop were presented and commented upon. A new strategy on the use of land and water is called for that is commonly developed by all the Ministries that are involved in Egyptian aquaculture. Such a strategy should take the present situation of fish farming in Egypt into consideration. When the strategy is developed in consultation with experts of the knowledge institutes and representatives of the private sector, the chance of acceptance by, and support from the private sector will be enhanced.

1 Introduction

On April 21, 2011 a workshop on integrated aquaculture –agriculture systems as a farming practice that uses Egypt's water resources more efficiently was held at Semiramis Hotel, Cairo. The workshop was organised by Wageningen UR Centre for Development Innovation (CDI) and the Egyptian Fish Council (EFC) which is under the Egyptian Agribusiness Association (EAGA) with support of the Agricultural Counselor of the Embassy of the Kingdom of the Netherlands in Cairo. The workshop was the final activity of the Policy Support project BO–10-011-102 which is financed by the Netherlands Ministry of Economic Affairs, Agriculture and Innovation (EL&I) and co-financed by project KAI0063686 (OS-project to strengthen the Egyptian fishery sector).

The objective of the workshop was to present the results of the study on water use at four Egyptian farms that apply integrated aquaculture – agriculture which was carried out by the World Fish Centre in 2010. In addition the results of other recent research undertaken in Egypt on integrated aquaculture – agriculture systems as well as experiences with such systems from outside Egypt were presented. The interest of the Netherlands Government in integrated aquaculture systems stems from the realization that expansion of Egyptian farmed fish production has to take the limited availability of freshwater resources into consideration, and can only take place by means of intensification of the systems that use fresh water (more fish production per m^3 of water), exploration of the application of integrated aquaculture – agriculture systems, and the use of brackish and salt water. Hence the attention in this workshop to fish farming in recirculation systems and the experiences of Rula for Land Reclamation Co, Wadi Group, with raising marine fish species in salt groundwater.

The workshop was attended by approximately 80 persons, mostly from the private sector and the academic, and one staff member of the Ministry of Water Resources and Irrigation. Eng. Sherif Rashed, chairman of the EFC, facilitated the workshop.

From left to right: Dr. Hans van der Beek, Eng. Sherif Rashed and Andries Kamstra

A number of the workshop participants

Program

A program of the workshop is found in Appendix 1.

2 Welcome and introduction to the workshop

The workshop was opened at 10.00 am by *Eng. Sherif Rashed*. He welcomed the participants and explained the absence of a representative from the General Authority for Fish Resources development (GAFRD, MALR).

Dr. Hans van der Beek, Counsellor of the Netherlands Ministry of Economic Affairs, Agriculture and Innovation (E,L & I), at the Embassy of the Kingdom of the Netherlands in Cairo, pointed out that fish farming in Egypt is a fast-growing sector but is also one of several sectors that claim a part of the limited freshwater resources of the Egyptian nation. Dr. van der Beek explained the history of his involvement in this sector and stressed that this workshop builds on earlier studies and workshops done in the past 6 years. He concluded by mentioning one of the preliminary recommendations of the most recent meeting of the Egypt – Netherlands Advisory Panel on Water Management (APP Panel) that stressed the need for a Common View on Aquaculture agreed between MWRI and MALR.

Mr. Peter G.M. van der Heijden, coordinator of the project BO 10-011-102, underlined the overlap of interests between the need to expand the Egyptian fish production in a sustainable way and with more water-efficient production systems on one hand, and the preliminary recommendations of the APP panel as were read by Dr. Hans van der Beek. In the past two years the focus of BO projects had been on integrated freshwater aquaculture- agriculture systems, but from 2011 onwards the focus of the new project would be on integrated systems that make use of brackish and salt water. He reminded the audience that the history of cooperation between Wageningen and Egypt in the field of fish farming goes back to the late 1970's, when the Department of Fish Culture & Fisheries of the predecessor of Wageningen University assisted the Government of Egypt with the set-up of grass carp hatcheries. The grass carp were destined for stocking in irrigation canals to control the excessive growth of water weeds.

3 Presentations

After a brief sketch of Wageningen University & Research Centre *Mr. Peter G.M. van der Heijden* (Wageningen UR Centre for Development Innovation) sketched the history of the involvement since 2005 of Wageningen UR in Egyptian aquaculture and listed some highlights, such as the 'Action plan to alleviate constraints hampering the further development of the fisheries sector in Egypt' that was written by Dr. Verdegem and Kees Taal (2005), the tailor-made training course "Reproduction of African catfish & aquaculture in recirculation systems" (held in August 2006), participation in the seminar on "Sustainable aquaculture in Egypt: developing the export value chain" (September 2007) and the study visit by EFC members to Dutch fish farms applying recirculation systems (June 2008). He summarized the main results of the BO project of 2009 'Integrated aquaculture in Egypt", which among other things concluded that:

- that various forms of integration of fish farming and agriculture were already practiced in Egypt but its application on a wider scale was confronted with several institutional and juridical challenges that relate to the regulations on the use of fresh water and agricultural land;
- in the debate in Egypt on the use of fresh water for fish culture hard date on water use in (integrated) fish farms were in short supply.

The objectives of project BO 10-011-102 in 2010 were to collect data on water use in integrated fish farms as well as obtaining a better picture of the institutional and juridical challenges that integrated fish farms are facing. The main findings and conclusions of the short study of legal and institutional challenges, opinions and perceptions on water use in integrated fish farming that was done by the consultancy firm Synergie are described in the report of the study (D. van Groen, 2010)[1] and can be summarized as follows:

The most important laws affecting water use are:

- Law 48/1982 of Ministry of Environment that aim to protect the quality of inland water.
- Law 124/1983 that gives the right to first use of irrigation (Nile) water only to domestic & agricultural purposes and for fish hatcheries. Fish farms (grow-out) are allowed to use drainage water and brackish water. This brings the risk of accumulation of agrochemicals in farmed fish. Use of groundwater from dessert land is part of land use permit issued by MWRI. The permit to use groundwater is related to status of local aquifer.
- Most important regulation affecting land use is Law 124/1983, which states that only fallow land can be used for fish farming. Resolution 70/1986 by GAFRD makes this more explicit by stating that only sterile land and land not fit for crop production can be developed into fish farms. The objective of this law is to protect 'old' agricultural land from conversion to other uses but it poses complications to the rotation of aquaculture and agriculture, such as the growing of cereal crops on the bottom of fishponds during the winter season.

In a conversation held on July 21, 2010, with the Lab Director of the Central Laboratory of Residue Analysis of Pesticides and Heavy Metal in Cairo Mr. Van der Heijden was informed that regular monitoring of residues in fish for domestic consumption has not taken place in the past decennium. Older publications that reported on the levels of heavy metals and agrochemicals in fish from both capture and culture are available but these seem not to have led to any activities by the authorities concerned.

[1] D. van Groen (2010) *Short study of legal and institutional challenges, opinions and perceptions on water use in Integrated Fish Farming: an inventory and some suggestions for ways forward*. SYNERGIE Consultancy for International Cooperation, Alkmaar/Cairo.

The objective of the BO project for 2011-2012 is to look deeper into integrated saltwater aquaculture – agriculture systems by studying if salty or brackish waste water from fish farms can be used for saltwater-resistant crops and for intensive fish farming applying biofloc technology.

Discussion

One member of the audience reacted by confirming that one of the first aquaculture projects where Wageningen University was involved, the establishment of grass carp hatcheries, was still active and regularly producing grass carp for clearing the irrigation and drainage canals. He also requested Wageningen UR's involvement in an development project that would test aquaculture – agriculture integration in remote areas for Bedouin communities

Dr. Dia Kenawy (World Fish Center, WFC) presented the results of earlier research by the WFC on integrated aquaculture –agriculture. In 2008-2009 WFC has measured various sources of water loss from ponds at 2 fish farm sites in Egypt. In one site the daily water loss was 54.1 m^3/ha day of which 90% was due to evaporation and the rest was lost through seepage. At the second site the daily water loss was 46.4 m^3/ha/day (97% due to evaporation). The harvest was 3 tons fish/ha in site no. 1 and 8.3 tons in site no. 2. Water consumption was equivalent to 3.61 m^3 and 1.13 m^3 of water per kg fish produced. In Table 1 the water use efficiency and the value of the product per m^3 of water of several agricultural crops and farmed fish are compared.

Table 1. Comparison of water efficiency and crop value of various crops and farmed fish.

Crop	Average water use (m^3/ha/crop)	Production (tonne/ha)	Water use rate (m^3/ kg)	Product value (US $ / m^3 of water)
Rice	14476	9.685	1.27	0.05 – 0.18
Fruits	11343	11.667	0.74 ; 0.97	0.80 – 4.0
Cotton	6719	2.349	2.86	
Maize	6271	6.998	0.89	0.03 – 0.22
Soy bean	6326	2.875	2.2	
Fish (literature review)	20,000 ; 45,000	5.0	4 - 9	0.07 – 1.35
Fish (2008-2009 study by WFC)		3.0 ; 8.3	3.61 ; 1.13	0.31 ; 1.05

In a different series of experiments WFC compared the productivity of ponds only stocked with fish with:

- fish ponds in which rice was grown in the central area, and
- ponds in which, after the fish harvest, a crop of wheat was sown on the pond bottom.

The latter system proved to be the most productive and the most water efficient because the wheat showed a good growth and harvest (5.4 tons/ha) using only the water remaining in the pond bottom after the fish harvest of 2.8 tons/ha (no extra irrigation water was needed). As mentioned before, fish farmers that would practice this system may run into problems because of violation of Law 124/1983 and Resolution 70/1986 by GAFRD: a successful crop of wheat proves the land suitable for agriculture and the use of land that has proven to be suitable for agriculture for fish farming is prohibited.

Dr. Ahmed Nasr Alla (World Fish Center) presented the results of the 2010 monitoring study on water use and water quality in four farms practicing integrated aquaculture – agriculture. [2]Two of the farms had fish farming as most important production activity and used fresh well water. The effluent of the fish basins was used to irrigate fruit trees and crops. The two other farms used water from the irrigation canal and had the production of fruits and vegetables as most important activity. The latter farms stocked fish in reservoirs which had as main purpose the storage of water for irrigation during days when not enough water was available in the irrigation canal. Water from the inlet, from a selected number of ponds and from the drainage canal was sampled monthly and the most common water quality parameters(Nitrate, Nitrite, NH_4, available Phosphorus, Potassium, Dissolved Oxygen and pH) were analyzed in the WFC laboratory. Data on water use from each farm, the amount of crops and fish that was harvested and the sales price were obtained from the farm records.

Table 2. Characteristics, water use and harvest data of the four integrated farms

	Farm no. 1	**Farm No. 2**	**Farm No. 3**	**Farm No. 4**
Surface area (feddan)	60	30	1600	380
Total volume of fish tanks & reservoirs (m^3)	7620	5040	8000	107100
Water exchange rate % in tanks & reservoirs	20	6	45	8
Average daily water use, m^3	1524	302.4	3600	8568
Total annual water use, m^3	556260	110376	1314000	3127320
Total fish yield in 2010, kg	189000	40800	6000	0
Water use efficiency in fish production (m^3/kg)	2.94	2.71	219.00	No harvest yet (February 2011)
Fish Yield per cubic of water (kg/m^3)	0.34	0.37	0.005	0.000
Value of fish sale	1,701,000	367,200	54,000	0
Crops	Mango, banana, orange, vegetables, flowers	Mango, alfalfa (new farm)	Mango, orange, grapes, vegetables,	Banana, lychees, mandarins, orange
Total Value of crops (LE/Year)	450,000	10,000	4,339,000	6,630,000
Revenue from fish to total farm revenue in 2010	79%	97%	1%	0%
Revenue of fish & crops per cubic m^3 of water (LE/m^3)	3.76	3.61	2.36	2.46

Average water use per farm ranged from 320 to 7390 m^3/day, depending among other things on surface of the land area to be irrigated, type of crops and the quantity of fish that was kept (Table 2).

The two farms that used well water and for which fish was the main source of income, used 2.7 m^3 and 3.1 m^3 of water per kg of fish produced. For the two farms for which crops and fruits were the main

[2] A. Nasr Alla, D. Kenawy, G. El-Naggar & M. Beveridge (2011) Evaluation of the use of fresh water by four farms applying integrated aquaculture - agriculture in Egypt. World Fish Centre, Cairo/Abbasa, Egypt.

source of income the water use for the fish can be neglected because the intake of water for the farm is completely determined by the demand of the crops and trees. It should be noted that the data in Table 2 are gross sale figures and the detailed production costs have not been taken into consideration.

Based on their experience and comparison with farms without fish culture the farm owners/managers estimated the amount of fertilizer they had saved by integrating fish culture in their farm water management. Their estimate ranged from LE 7185 to 42000, with the highest estimates by the owners/managers of the farms where fish was the main crop. For three out of four farms the Total Nitrogen, Phosphor and Potassium levels of the fish pond effluent was higher than the levels of these plant nutrients in the incoming (well or irrigation) water. Making use of the monthly water quality analysis of inlet water and fish pond effluent and of the data on volume of water that passed through the farms the amount of plant nutrients (X) that is added if the water is used first for fish culture and next for irrigation was estimated, using the formula

$$\text{Nutrient X added (gr)} = [X_{\text{(in effluent, mg/l)}} - X_{\text{(incoming water, mg/l)}}] * \text{Volume } (m^3)$$

In most farms the fertilizing effect of fish culture was very small for Phosphor, but significant for Nitrogen and Potassium (Table 3). In farm No. 3 no fertilizer effect could be established because the average N, P and K content of the water in the drainage canal (containing pond effluent) was lower that the level of all these elements in the water of the irrigation canal.

Dr. Ahmed Nasr Alla presenting

Table 3. Estimated fertilizing effect of fish culture on irrigation water

Fertilizer effect (kg/day) due to fish culture	Farm 1	Farm 2	Farm 3	Farm 3
Total Nitrogen	2.17	0.61	-0.14	5.58
Available Phosphor	0.002	0.02	-0.17	0.86
Potassium	3.76	0.77	-8.71	3.40

When the results in Table 3 are multiplied with the number of days in a crop growing season a rough estimate is obtained of the amount of fertilizer saved due to fish farming. It is obvious that three of the four farms that were monitored saved from several hundreds to over 1000 kg of fertilizer per crop growing season.

The analysis showed that the difference in salinity between pond effluent and source water was very small (0.3 ppt in farm 1, negligible in the other farms).

The managers and owners of the farms that took part in this monitoring study were invited for the training course "Practical considerations in managing integrated aquaculture – agriculture in Egypt" that was held July 25 – 29 at the World Fish Center in Abbassa. From Wageningen UR Dr. Mac Verdegem and Mr Peter G.M. van der Heijden provided input in this course.

The presentation of Dr. Ahmed Nasr Alla raised questions about the technology and methods used. Dr. Nasr Alla stressed that this study monitored the existing situation on farms that already applied integration for some years, and could not be compared with on-station research where all factors are better controlled. It was mentioned that the fish feed composition and quantities should also be monitored in this type of studies. Also the fish densities in relation to the oxygen levels of the water were a point of discussion. Paddle wheels played an important role in the oxygen supply in farm 1 and 2, while the oxygen level in the irrigation water reservoirs was regulated by the regular replacement with water from the irrigation canal. The fluctuations in nitrogen levels and the way seepage was measured in the studies presented by Dr. Dia Kenawy were also brought up.

Dr. Ismail Radwan (Egyptian Aquaculture Centre, EAC) presented "The role of learning by doing in technology transfer of intensive tilapia farming from the Netherlands to Egypt." Dr. Radwan sketched the process of fish farming development and intensification in Egypt since the 1970s. The building of Aswan High Dam (that reduced the annual flood cycle of the Nile), the application of partial pond flushing, aeration and sex reversal are major steps that contributed to the expansion, intensification and growth of total tilapia production in ponds in Egypt. Dr. Radwan explained that his first impression of aquaculture in recirculation systems had not been positive due to the high investment costs. But as a practical person he was interested to apply it on his farm. This was made possible and more attractive after the information obtained from a training course in Wageningen (2006) and from a study visit to Dutch fish farms that apply recirculation systems (2008). The material support (two pumps, generator) provided by the Netherlands Embassy made the installation possible of a recirculation system at the EAC. Making use of 24 existing concrete fish tanks (10.8 m^3 volume) Dr. Radwan installed a sedimentation pond and built a trickling filter, producing the plastic filter material himself from plastic fencing material that is available locally. The recirculation system became operational in April 2009. Starting with 1000 pieces of 250 gr fish per tank, Dr. Radwan could harvest 450 kg/tank of fish after 100 days, having reached a maximum fish density of 41.6 kg/m^3 tank volume. Since this first trial 2 more successful production cycles have taken place. The production cycle of 2010 resulted in 18,935 kg of fish with a total cost of LE 141,368 . The total sales value was LE 174,485 . Dr. Radwan is at present expanding his RAS facility with a moving bed filter.

Mr. Andries Kamstra (IMARES, Wageningen UR) pointed out that when considering water use in fish farming, the volume should be considered in relation to the kg of feed that was used, or to the kg of fish that was produced. In order to calculate water use in fish farms three aspects are important: Waste production as related to the feeding of the fish, water quality criteria and water treatment technology.

In pond culture besides evaporation also seepage can be a considerable cause of water loss, depending on the type of soil. With time seepage through pond bottoms becomes less due to accumulated organic material. The water lost through seepage has also a higher Nitrogen and Phosphor content than the water in the pond: up to 28% of the Nitrogen and 44% of the Phosphor in the fish feed can be lost with the seepage water. Growing fish that consume 1 kg of feed also produce 560 gr of CO_2, 40 gr of Nitrogen released as ammonium, and 100 to 250 gr of faeces. The removal of these waste products and the supply of oxygen will make water exchange necessary, but aeration and recirculation of water can reduce the water demand from 4 – 8 m^3/kg fish production in night-time aerated ponds to less than 0.5 m^3/kg fish produced in intensive recirculation systems. After installation of recirculation systems (which was a requirement by the national government to reduce the environmental impact) trout farms in Denmark were able to reduce the water flow through their farms from 50 to 4 m^3 per kg of fish produced, obtaining the same or higher total production on a significantly reduced farm area. Application of denitrification filters in recirculation systems can reduce the water demand even more, to less than 0.1 m^3/kg of fish produced, as is shown by intensive indoor tilapia and eel farms in the Netherlands. Although recirculation systems have a low water use, the rationale for using these systems in Western Europe is year-round fish production in a temperate climate. This application could possibly be useful in Egypt for the production of large Tilapia fingerlings during winter.

Mr. Kamstra also pointed out the potential to grow sole (*Solea solea*) in Egypt: a fish that has a high demand and a good price both locally and in the international market, with few competing producers and the possibility for integration in the existing production of seabass and seabream in ponds.

Dr. Ismail Radwan

Mr. Andries Kamstra

After his presentation questions were asked about the farming of sole. Mr. Kamstra pointed out that sole is not a fast grower and can be very picky while feeding. The fish tolerates water of 10 ppt, but for optimal production it should be grown in water with a salinity of 15 ppt or more.

With a presentation that was very rich in photo's *Dr. Sherif Sadek* (Aquaculture Consultant Office, ACO) reported about actual production in integrated aquaculture-agriculture farms and about the results of the marine fish farm of Wadi Group, at Rula For Land Reclamation company, in Wadi Natroun area. At present more than 100 intensive tilapia farms and 14 pioneer commercial fish farms are integrated with

the agriculture irrigation system and animal production using the underground water in the Egyptian desert.

The farm at Rula For Land Reclamation has been in operation since 2008 and is growing sea bass and sea bream in 26 ppt, 26 ºC well water. The fish are housed in concrete tanks under a plastic greenhouse cover and kept in maximum target density of 20 kg/m^3. The water temperature in the tanks ranges between 21 and 26 ºC, The farm grows sea bass in three stages: fry to fingerlings of 20 gr (5 months), pre-growing to 200 gr (7 months), and finishing (from 200 to 800 – 1,000 gr, 16 months). The water of the nursery unit is recirculated after passing a drum filter and a trickling filter, which reduces the water demand to 1.7 m^3/ kg of fish. In the on-growing and finishing stage a flow through system is used, and water demand is 7.3 m^3 and 18 m^3/kg of fish respectively.

From an initial batch of 72,000 sea bass fry (less than 0.2 gr, age 65 days), 25,000 could be harvested as market-size fish after 20-24 months. Various skeletal and gill cover deformities and bacterial (*Vibrio* and *Pasteurella*) and ectoparasite (*Oediunum* spp) diseases pose challenges to the farm.

In collaboration with Wadi Group, ACO has started experiments to develop aquaculture – agriculture integration based on saltwater fish farming. The companies are testing the growth a of salt-tolerant crops such as salicornia, jojoba and other halophytes plants irrigated with fish farm effluent. Expansion of these experiments in cooperation with Wageningen UR in 2011 is planned. Dr. Sadek pointed at the need for further research in this subject and to learn from experiences with integrated saltwater farming obtained in other regions of the world.

From left to right:
Mr. Mohamed Sabry (ACO), Eng. Eslam Smadony (Rula for Land Reclamation), and Dr. Sherif Sadek (ACO)

4 Conclusions and recommendations

In the final stage of the workshop the main conclusion and recommendations were presented for the audience to comment upon.

4.1 The conclusions of the workshop are:

1. All stakeholder (consumers, farmers, fish farmers, government of Egypt, the environment and future generations) benefit when water resources and minerals are used as efficiently as possible.

2. The integrated system of water use "first fish, than crops" has the following advantages:
   - It uses water and nutrients more efficiently;
   - Reduces the risk of contamination of fish with agrochemicals;
   - Reduces unwanted pollution from fishponds going to the environment;
   - In general, from an agricultural point of view, it enhances the quality of irrigation water.

3. The integrated system of water use "first fish, than crops" has the following disadvantages:
   - More organic matter in the water, which makes the use of filters almost a necessity when drip irrigation is applied.
   - The present capacity of canals and pumping stations will impose restrictions on its wide-scale implementation, requiring modifications of fish farm practices and better planning, management and coordination among farms of water intake and discharge.

4. Intensification of fish production (more kg fish/m^3 of water) can lead to higher revenues for the producers.

5. Intensive fish farms in Egypt use at present 2.7 – 3.1 m^3 water per kg of fish produced (with aeration, no recirculation).

6. Re-use of fishpond effluent (recirculation) can lead to further and significant decrease of water use in fish farming (presentations of Dr. Radwan and Mr. Kamstra).

7. Use of brackish and salt water for aquaculture is already taking place (presentation of Dr. Sherif Sadek, Rula Co – Wadi group and Dr. Radwan). The integration of brackish/salt water fish farming with saltwater agriculture is at its infant stage of development in Egypt.

4.2 The technical recommendations of the workshop were:

1. Integrated systems and innovations that lead to more intensive fish and crop production in fresh water (more kg product/m^3 water) deserve support and further study. When expansion is taking place, attention should be given to minimal burden to the environment.

2. Further development of aquaculture using brackish and salt water deserves to be supported but attention should be given to minimal burden to the environment.

4.3 The recommendations regarding institutional aspects were:

– A new government offers an opportunity for a new vision and a new approach.

1. Development of a common strategy and approach regarding land and water use for fish farming by the government bodies most concerned with aquaculture (Minister of Agriculture,& Land Reclamation (MALR) , Ministry of Water Resources & Irrigation (MWRI) and the Ministry of State of Environmental Affairs (MEA) is recommended. Development of such a strategy should take place in a transparent way, taking into consideration the (new) facts and present situation regarding Egyptian aquaculture.

2. Acceptance and support for such a common strategy would be enhanced if the development takes place in consultation with experts from knowledge institutes and the representatives of the private stakeholders.

The central offices of the various relevant government bodies have a responsibility to make sure that the interpretation and implementation of such a common strategy at all governance levels (national, governorate and local) is similar and coherent.

Appendix 1

Workshop program

Integrated aquaculture – agriculture in Egypt: towards more efficient use of water resources

Thursday, April 21st, 2011
Semiramis Intercontinental, Thebes Room

09:00 Registration & welcome coffee break

09: 30 Workshop opening speech by:

- Dr. Mohamed Fatty Osman
  President of the Agriculture research center- ARC
  & Chairman of General Authority for fish resources development –GAFRD)

- Dr. Hans van der Beek
  (Counsellor for Agriculture, Nature and Food Quality
  Embassy of the Kingdom of the Netherlands)

- Dr. Samir El Naggar
  (Chairman of the Egyptian Agribusiness Association EAGA)

- Mr. P. G.M. van der Heijden
  Fisheries Management and Aquaculture, Wageningen UR
  Centre for Development Innovation (CDI)

10:30 Coffee Break

10:45 First Session

1. Background of the project and juridical context
   (Mr. P. G.M. van der Heijden, Fisheries Management and Aquaculture, Wageningen UR - Centre for Development Innovation (CDI))

Q & A

2. Results of the study on water use in selected integrated farms
3. Results of research on integrated aquaculture – agriculture systems in Abbassa
   (Dr. Ahmed Nasr Alla) & (Dr. Diaa Kenawy) – The World Fish Center, Abbassa)

Q & A

13: 00 Coffee Break

13:15 Second session

4. Results of fish culture in recirculation system
   (Dr. Ismail Radwan - Egyptian Aquaculture training Center)

Q & A

5. Water Suppletion in freshwater Aquaculture
   (Mr. Andries Kamstra - Researcher, IMARES, Wageningen UR)

Q & A

6. Fish & Shrimp culture in salt ground water – lessons learned from the first three years 2008-2011
   (Sadek S. Sherif (1), Sabry A. Mohamed (1) and Eslam El-Samadony (2).
   (1) Aquaculture Consultant Office, (2) Rula for Land Reclamation co.

Q & A

15:00 Closing session

Remarks & Conclusion (Mr. P.G.M. van der Heijden - Fisheries Management and Aquaculture)

16:00 Lunch

Eng. Sherif Rahsed (Egyptian Fish council (EFC) – EAGA)
The workshop moderator.

Results of recent studies, research and practical experiences from Egypt and abroad with forms of aquaculture that use water en nutrients more efficiently than common pond culture were discussed at a workshop held in Cairo (April 21, 2011). The presentations include the results of a study undertaken on four Egyptian integrated aquaculture – agriculture farms where water use, effluent water quality, fish harvest and revenue from crop and fish sales in 2010 were monitored.

More information: www.cdi.wur.nl

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