Aquaculture Europe 2014 - Adding Value

aquaculture europe

VOL. 38 (2) SEPTEMBER 2013

THE STATUS OF EU ORGANIC AQUACULTURE

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THE MEMBERS' MAGAZINE OF THE EUROPEAN AQUACULTURE SOCIETY

2nd Semester 2013
Afgiftekantoor: 8400 Oostende Mail

Bustan Aquaponics:

Egypt's first working commercial aquaponic farm

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The owner of Bustan Aquaponics, Mr. Faris Farrag (Photo: Peter G.M. van der Heijden)

At the northern edge of Cairo, close to the main road to Alexandria, Egypt's first commercial aquaponics farm is located. The owner, Mr Faris Farrag, applied the concept that was developed by Dr James Rakocy of the University of the Virgin Islands. In Bustan Aquaponics farm vegetables and fish are part of one integrated recirculation system. The vegetables benefit from the nutrients provided by the fish through a nitrification cycle that converts toxic ammonia from fish waste into nitrate, making the water suitable again for the fish and highly nutritious for the plants.

The construction of Bustan Aquaponics farm started in 2011. The farm is self-funded by the owner and investments to build it were in the range of 300,000 Egyptian pounds (approx. US $ 50,000). Work on the farm is done by the owner, the farm manager and one labourer. A caravan near the farm site accommodates the office and a separate sleeping quarters for the on-site manager.

The aquaponic farm sits on 1000 m^2 of land within an eight acre olive orchard and consists of two greenhouses made of fine meshed netting material. The larger greenhouse is the horticulture unit, containing a deep channel raft system, consisting of six 30 m long basins with xps polystyrene foam plates floating on the water surface on which the vegetables and herbs are growing. In the smaller greenhouse the fish tanks and water treatment system are placed. The greenhouses are placed 3 m apart and are connected through 2 underground tubes through which the water flows from the fish unit to the horticulture unit and back again.

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The fish unit

The fish unit consists of 4 round tanks of 8 m^3, each stocked with 600 tilapia *Oreochromis niloticus.* The tanks are intensively aerated with air stones. The fish are grown using extruded pellets of a local brand, 32% crude protein level, to a market weight of 800 – 1000 gr. In winter water temperatures drops to 17° C or lower and fish growth comes to a near stand-still. To address the issue of cold water temperatures in winter, especially at night, the fish tanks are insulated. The possibility to install a solar heating system and use of greenhouse material that provides better insulation are studied. Besides from Nile tilapia other (combinations of) fish species will be tested. The response to the quality and size of the fish has been overwhelmingly positive. Although Egypt has a very large market for farmed tilapia, the quality of the product and the clean process used in this system is quickly finding appreciating clients in both retail and wholesale markets.

The water in the tanks is recirculated continuously. After leaving the fish tank the water enters a clarifier that consists of a round fiberglass tank with several baffles placed at an angle that slow down the flow and cause particle sedimentation. Each day the sludge accumulating at the bottom is drained and collected in a PE lined pond beside the greenhouse. In this pond the solid section of the waste water is filtered and collected in a burlap sack for further use as a high quality compost; the water is used to irrigate the olives trees.

After passing the clarifier the water flows through a second particle trap consisting of two rectangular fiberglass basins filled with netting material. While flowing through these basins to the outlet most of the smaller particles attach to the nets. The nets are regularly removed and rinsed, the frequency depending on the amount of feeding. The water coming from the sediment traps comes together in an intensively aerated square tank where the oxygen level is raised and carbon dioxide is removed. From here the water flows to the horticulture unit by gravity.

The vegetable unit

In the large green house the water flows into three long basins (30 m x 1.25 m, 30 cm deep). The walls of the basins are made of hollow blocks and concrete; a lining consisting of 400 micron thick PE makes the basins waterproof. The water surface is covered with 3 cm thick high-density floating polystyrene plates pierced with round holes of approx. 5 cm diameters at varying distances depending on the size of the plant. Small plastic pots with seedlings of vegetables and herbs are clamped in the holes with the roots hanging in the water, absorbing

The large greenhouse that contains the vegetables unit (Photo: Ziad Abou El Nasr)

Overview of the fish unit with round fish tanks at the back and clarifiers at the front (Photo: Ziad Abou El Nasr)

Harvested tilapias are stored on ice (Photo: Ziad Abou El Nasr)

Overview of the greenhouse with several varieties of lettuce (Photo: Ziad Abou El Nasr)

Endive plants (Photo: Ziad Abou El Nasr)

the phosphate, nitrate and other compounds present in the fish farm effluent. The fish farm water however does not have all elements necessary for an optimal growth of the crops; iron compounds and occasional calcium supplements to aid in stabilising the pH level are added regularly. The pH of the water is maintained around 7, a compromise between what would be optimal for the plants and optimal for the fish. The water in the long, shallow basins is aerated by means of 30 air stones per basin to provide the roots with oxygen and to enable conversion of ammonium to nitrate by bacteria. At the far end of the 30 m long basin the water is directed to an adjacent basin of similar proportions through which it slowly flows back to the fish unit, passing again through the roots of the vegetables. In the fish unit the water collects in a sump; a 1.5 Hp pump moves the water from the pit into the fish tanks. An automatic device with floater feeds the system with additional water when needed to maintain the overall water levels.

The horticulture production

Vegetable sale started in October 2012. We are still testing which crops and cultivars are doing best in this system and in the Egyptian desert climate. Vegetable and herbs are currently being seeded at a neighbouring farm until our own greenhouse is completed. We have successfully grown many varieties of lettuce (such as Parris Island, Esmaralda, Greenwave,Red Sierra, winter endive, Four Seasons etc), spring onion, endive, basil, pakchoy and water cress. Additionally, we are going through our first fruit and herb crops of three types of heirloom tomatoes, borlotti beans, yellow string beans, chilli peppers, wild rocket and sweet basil.

Plant pests and diseases are treated with insect traps (such as glue-covered paper in colours that attract insects), and by biological pest control through Biogate, a biological pest control company that was set up concurrently with the aquaponics project. Biogate provides predators such as ladybugs and wasps in addition to a range of bio-insecticides, parasitoids, and predatory mites. (www.biogatesystems.com). The possibilities of Integrated Pest Management (IPM) such as companion planting, with one species protecting the other because its smell is unattractive to insects that would love to feed on the neighbour vegetables. The total vegetable basin surface of 225 m^2 can produce at least as much vegetables and herbs as from 500 to 600 m^2 of land. Strawberries grown in Nutrient Film Technology (NFT) are on the list for testing in the near future. Sustainability and care for the environment are basic principles of Bustan Aquaponics.

Pakchoy plants resting in floating foam plates (Photo: Ziad Abou El Nasr)

Marketing

Bustan delivers high-quality, organic vegetables to the market. The good quality of our lettuce is already well known among the buyers. We are still exploring the niche for our type of products and sell directly to consumers on farmer's markets in greater Cairo, to hotels, restaurants, organic vegetable shops in the more affluent neighbourhoods and in our own brand farm shop we have recently set up. Bustan Aquaponics also would like to play an educational role: The farm will soon be opened regularly to Cairo city folk who will be informed about the production process and can buy the fresh products. School children are welcome to see how the fish and vegetables are grown, to plant a few seedlings themselves and come back some weeks later to harvest their 'own' heads of lettuce or other vegetables. We plan to add a cooking unit and offer visitors a meal made from what the farm produces.

Testing, perfecting and expansion

Bustan Aquaponics farm now consists of one module that serves as a pilot in which the design and operations are tested and developed. We have been through a steep learning curve, finding out about suppliers, learning what is the most suitable equipment and what are the best inputs, crops and cultivars and exploring the best markets for the products. The practical, hands-on experience with construction, operation and marketing will be of great value for the next phase, which consists of a farm made of 6 modules, each similar to the one described here. Expected production from such a 6 module farm is 30 to 45 tons of fish, 150,000 heads of lettuce, 40,000 – 50,000 bunches of chives, basil and other products. A fish hatchery to produce own fingerlings and a nursery to grow vegetable seedlings from seeds are also in the plans.

Bustan Aquaponics is looking for technical and business partners to set up the larger version of the aquaponics farm described here.

Bustan Aquaponics open to collaboration and partnership with companies and institutions who shares his passion for high-quality crops and fish produced in an environmentally friendly and sustainable way. Interested parties should bring expertise on horticultural, practical engineering expertise, or marketing channels to the table. In particular, those parties with experience in process automation (constant electronic testing of water quality parameters, etc. Considering the owner's strong background in banking, new partners can be assured that the profitability of the next phase of Bustan has been well thought through and calculated.

Parties seriously considering to become Mr Farrag's business partner can contact Faris Farrag, farisfarrag@me.com.