



# aquaculture europe

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## AQUA 2018: Aquaculture in Occitanie, France



**Hans Ackefors**  
Aquaculture's true gentleman

**Urban farmers**

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'De Schilde' with the glass house visible on the roof  
(Photo: Martijn Zegwaard)

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## UF 002 De Schilde: Europe's largest rooftop aquaponics farm

In May 2016 the Swiss company 'UrbanFarmers' officially opened its second aquaponics farm, this time in The Hague, the Netherlands. Compared to the first farm in Basel (Switzerland) this second farm was more challenging: on the top floor and roof of a six-floors industrial building in The Hague. The farm produces 12 tonnes of tilapia and 40 tons of vegetables per year.

### UrbanFarmers: the start

The construction of the farm in The Hague started in November 2015. Building a farm in a big city has its challenges, building it on the sixth floor and on the roof of an existing building added another set of technical issues. The floors and roof have limits to the weight that can be carried and this restricts the depth of the basins that can be used. The 1200 m<sup>2</sup> glass house on the roof and the horticulture installation were installed by Van der Kleijn and the fish farm on the 6<sup>th</sup> floor was built by Fleuren & Nooijen. Both companies are specialists in their own field but the aquaponics farm as designed by UrbanFarmers requires that both specialist companies understand the requirements and limitations of each other's speciality and adjust the familiar design to each other's requirements to enable optimal production of both fish and vegetables in an integrated system.

### The design

The fish farm is located on the top floor of the building and consists of one recirculation system with drum filter, a submerged floating bed filter of about 8 m<sup>3</sup>, a unit with UV lights, a trickling filter, a cone where pure technical oxygen is added to the water, 10 fish basins of 1 m<sup>3</sup> each for raising the fry and fingerlings plus 20 grow-out basins of 4.6 m<sup>3</sup> each. Each fish tank has a double water supply: one with the water that has passed through trickling filter and one with super-saturated water coming from the oxygen cone. The total amount of water circulating in the farm is 130 m<sup>3</sup> of which 120 m<sup>3</sup> are in the aquaculture unit. The limits to the weight resting on the floors do not allow any basin to contain water deeper than 0.8 m. The water used by the farm is tap water. The water with sludge that leaves the drum filter enters a settling basin. After settlement the sludge is drained in

the sewage system; the water on top of the settled particles is channelled back into the floating bed filter.

The aquaculture and horticulture component of the farm are connected but in such a way that when needed, the connection can be closed and each component can function on its own. Daily approx. 10 m<sup>3</sup> of water from the fish farm is pumped to the horticulture component of the farm that is situated in a 1200 m<sup>2</sup> glass house on the roof of the building. The water is stored and gradually released into the recirculation system that is used to irrigate the crops. After leaving the storage tank the water passes a small mechanical filter before it enters the circulation system. The horticulture component consists of two units, each with its own water supply. One unit has only leafy vegetables like lettuce, herbs, etc, and one unit is for fruiting vegetables like tomatoes, eggplant, bell pepper, cucumber,



Unless indicated otherwise, all photos made by Peter G.M. van der Heijden

etc. The reason for this separation is that plants in their vegetative stage require lower levels of nutrients in the water than plants that are in the reproductive phase. For the leafy vegetables the water that comes from the fish tanks contains sufficient macronutrients (N, K, P, S, Ca, Mg, Na) and only micro nutrients such as Manganese, Iron, Zinc etc. have to be added for optimal plant growth. The crops that are producing fruits do require extra macro-nutrients on top of what is present in the water coming from the fish tanks. Priva, a company specialised in greenhouse climate and irrigation control, has installed an automated system called Nutrifit that frequently measures the level of all major nutrients in the water and automatically adds the required amount when the level of a certain nutrient has dropped below a critical threshold level.

The technique that is used for irrigation of the crops is a variation of the Nutrient Film Technique: plant roots are growing in a plastic-lined channel in which a perforated hose is placed. Water is flowing continuously through the hose, supplying the plant roots with the moisture and the nutrients they need. In this farm, an upgrade of a traditional NFT system called NGS (New Growing System) is used which allows the plant roots to grow in several layers and offers better growth conditions.

### Fish culture operation

Red Natural Male Tilapia (Red NMT) bred by the Dutch company Til-Aqua are stocked. Every 4 weeks a new batch of tilapia fingerlings arrives at the farm. After a number of weeks in the small fingerling units the tilapia are transferred to the grow-out basins. In the 4.6 m<sup>3</sup> basins 500 fish grow in 7-8 months to a size of 500-600 gr/piece, which means a density of 50-60 kg/m<sup>3</sup> at harvest time. The fish are fed with special tilapia feed produced by Coppens International. Automatic feeders are supplying the fish automatically during 12 hours/day, with 8 meals per day for the fish in the nursery and 4 meals per day for the fish in the grow-out basins. Fish are sampled and weighed regularly and the data is fed to a software programme called 'Fishtalk' (produced by Akva Group from Norway). This programme computes the daily feed ratios for each tank. The FCR is 1.15 to 1.20.



Overview of the fish unit.



Red tilapia in grow-out tank



Luis Paim Sotto Mayor Negroo scooping some tilapia. (Photo: Francis Lukombo)

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Fruity vegetable section with tomato plants. Notice carton boxes on the floor where bumble bees stay, and metal rails for lorries that also serve as heating system.

The pH of water in the fish farm is automatically kept at 6.5 by regular addition of Calcium Hydroxide ( $\text{Ca}(\text{OH})_2$ ) solution. The DO level of the water in the fish basins is kept at 6.5 to 7.0 mg/l and as long as the visitors behave quietly the fish swim around very relaxed and calm. The water temperature is 28 °C.

Every week one grow-out basin with 500 fish is harvested. After harvest the basins are disinfected before a new batch is stocked. So far the farm did not have major disease problems.

The fish are sold according to the customer's wish (closed, gutted or as filets). The filets are sold in sealed bags labelled as 'Big City Swimmer'. The fish and the filets are sold to businesses (restaurants, shops, caterers, etc.) and directly to consumers who can come daily to the UrbanFarmer's shop or to the bi-weekly 'roof market' that is organised by UrbanFarmers. The price of whole fish is € 7.00/kg when sold to companies and a bit higher when sold directly to consumers. The filets cost more, of course. UrbanFarmers do deliver to their regular business clients when they are based in or near The Hague.

### Vegetable culture operation

The water that leaves the fish unit has a maximum EC of approx. 2000 mS/cm. The nutrient level of the water in the horticulture unit increases gradually due to water evaporation and the regular addition of plant nutrients by the



Leafy vegetable section with lettuce and other vegetables

Nutrifit installation and the pH regulator. When the EC reaches a level of 3500 mS/cm, part of the water is channelled back to the fish farm and is replaced with water from the fish unit that has a lower EC. The mineral that tends to reach a critical level first (i.e. a level that is harmful to the crops) is sodium ( $\text{Na}^+$ ): levels higher than 5 mmol/l (1.15 gr/l) will cause problems in the crops. The pH of the water in the horticulture component is kept at 5.8.

The glass house at the roof of the building is separated in two sections; The leafy vegetable section is kept in winter at 16-18 °C, the section with fruit-bearing vegetables is kept at 20 - 22 °C. In the cooler parts of the year the green house is heated by gas heaters that warm water that is pumped through metal pipes that lay on the floor between the rows of vegetables. The metal pipes also serve as rails for the trollies that

can move between the fruity plants to transport the harvest. In winter extra lamps make sure there is 18 hours of light for the crops. The farm produces several varieties of lettuce, baby leaves (micro-greens: seedlings that are harvested two weeks after germinating), spinach, 15 species of herbs (basil, chives, parsley, etc), several varieties of tomatoes, 2 varieties of aubergine, several varieties of cucumber, bell pepper and other varieties of sweet pepper.

The pollination of the flowers in the fruit-bearing vegetables section is done by the hundreds of bumble bees that live in the greenhouse. The bees are provided by Koppert, a company specialised in biological pest control. Besides from pollinating bumble bees this company also provides a variety of insect predators, pheromone-loaded insect traps and parasites that all have a role in keeping the harmful insects and plant pests under



control in a biological way. No chemical pesticides are used.

Tomatoes and other fruits that have some spots or that do otherwise not qualify for the A-quality label are used for the juices, soups and other processed products. The vegetables and herbs are marketed in the same way as the fish. Harvesting takes place 2 times/week, total production is about 40 tonnes per year. Part of the crop is harvested and taken home by the paying visitors at the end of their tour through UrbanFarmers.

Three UF staff members plus some intern students work in the fish and vegetable farm. Seven staff members work in the office and/or act as event hosts or guide for the people that visit UF 002 each week. The income from the visitor tours are part of UF's business model but also serve to show the city population how fish and vegetables are produced in their own city in an integrated and very water-efficient system.

### Typical urban farming rooftop issues

Running a horticulture farm on the roof of a 6 floors building in a big city brings its own typical challenges and issues. The price for water and gas is for Urban Farmers the same as for the citizens of The Hague, which is higher than for the horticulture companies in the nearby rural. This makes competing with such companies only on price nearly impossible. Customers chose UrbanFarmers products because of the quality and pesticide-free production process that takes place in their own city in an integrated fish-vegetables system that can be visited.

Also the additional light in the greenhouse during winter evenings is in a big city not without questions. It has raised complaints from the neighbours who thought this was too much light in the sky during the night in their neighbourhood. For the coming winter season UrbanFarmers is considering the possibility of operating the horticulture farm for one season, without adding hours of light to the natural photoperiod.

Working on a rooftop has the advantage of a beautiful view for employees and visitors, but it makes daily logistics more complicated. All inputs that arrive at the farm, like fish feed or fingerlings, and all output that leaves the farm (vegetables, fish and material destined for composting) have to travel up and down in the elevator. Smooth operations are very dependent on a well-operating elevator.

### The future

UrbanFarmers plans to open more farms in Europe and also elsewhere. The next aquaponics project, UF 003, is under construction in Zürich, Switzerland. This new farm will be on the ground floor, with the greenhouses built on top of the aquaculture system. It is expected to open in 2018 and it will grow 15 tonnes of tilapia per year, together with many varieties of freshly harvested vegetables. The accumulating experience of UrbanFarmers with aquaponics in an urban environment is a valuable company asset and an advantage when choosing the right site and housing for a new farm, but also for the design, construction and operation.

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