Farming our way to a more sustainable future

Two years ago, OL *took a tour of the then recently-developed United Arab Emirates University's aquaponics system. Last month, we made a return visit to see how far the facility had come along and to meet Dr Ibrahim Belal, the man spearheading the university financed Aquaponic Productivity project...*

In 2014, United Arab Emirates University's (UAEU) College of Food and Agriculture's Aridland Agriculture Department launched the first aquaponics system in Al Ain.

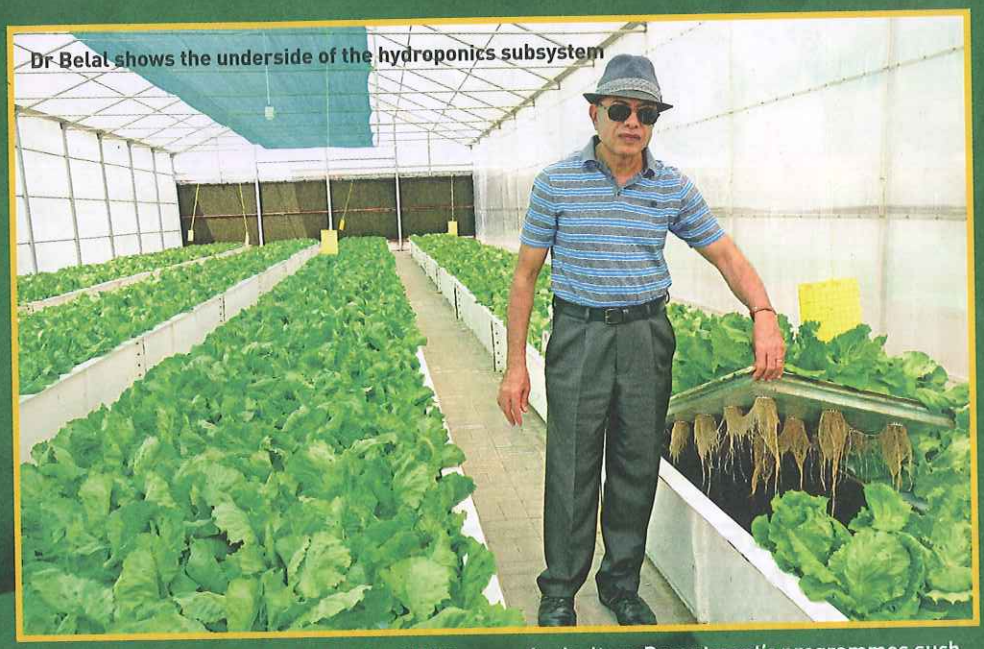
Aquaponics, in the most simplest of terms, is a combination of aquaculture and hydroponics – raising aquatic animals and growing plants in water instead of in soil, respectively. The process of aquaponics combines these two in an effort to employ a more sustainable approach to agriculture.

"When we first started just over two years ago, it was purely on a trial basis. We were trying many commercial crops to figure out the biological and economic feasibility of each crop," explained Dr Ibrahim Belal, Associate Professor and Aquaculturist, who has been in Al Ain and at UAEU for the past 12 years.

"Now, we are more focussed on feasibility and conducting research on specific crops such as lettuce, cucumber and tomatoes," he added.

The facility is home to four greenhouses, three of which are used for experimentation purposes and one for "demonstration or show", as Dr Belal puts it. Each greenhouse features two containers of tilapia (freshwater fish), a Swirl Separator , biological filters and four troughs where the plants are grown.

Most aquaponics' systems make use of tilapia as they are quite resilient and also hold the ability to reproduce at a high rate. "A female tilapia produces five eggs to each gram of her weight," explained Dr Belal, adding: "For instance, if she weighs 100g, then she will produce 500 eggs, and they reproduce monthly."



Dr Belal shows the underside of the hydroponics subsystem

In the system monitored by Dr Belal at UAEU, the fish are first bred in the Breeding Room of the facility and then the eggs are taken to the Hatchery where they are kept in a 'hatching jar'. The eggs hatch within five to seven days and are then added to a tank with other tilapia until they reach the size of fingerlings. At this point their feed is portion-controlled to keep them at this manageable size.

"This process takes around 45 days, after which they are added to the aquaponics system," Dr Belal explained.

With the high number of tilapia produced, a number of fingerlings are used for research and study purposes for students in the Aridland Agriculture Department's programmes such as Marine Fisheries and Animal Sciences, instead of being added to the aquaponics system.

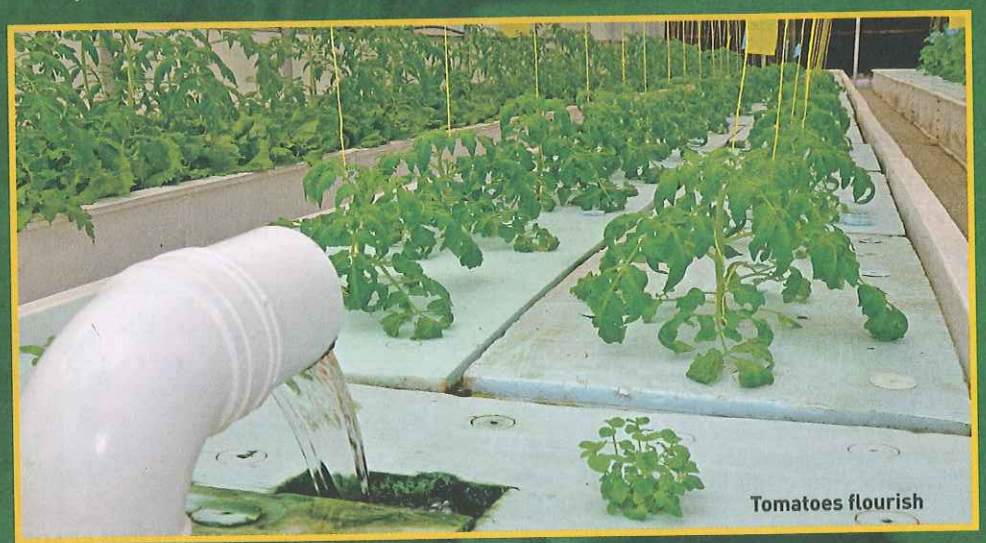
The tilapia that are used in the aquaponics system, play an important role in nurturing the plants. As time progresses and the fish are fed, the water in their tank soon becomes toxic due to the presence of ammonia in their excrement.

This water is circulated to the connected Swirl Separator which acts as a mechanical filter, separating the large particles (such as uneaten food and excrement) from the water, which then moves to the biofilter.

"The biofilter contains small plastic pieces with a large surface area which facilitates the growth of bacteria," said Dr Belal. It is this nitrification bacteria which helps convert the ammonia into nitrates, which are nutrients for plants.

This nutrient-rich water is then pumped into the hydroponics subsystem where plants are grown by absorbing the nutrients, thus effectively 'cleaning' the water to be pumped back to the rearing tanks, where the tilapia are kept to grow.

"Through this process, not only are we producing produce more quickly – lettuce, for example, takes 21 days to a month instead of the usual three months – we are conserving water as well, because it is cycled through," explained Dr Belal.



Tomatoes flourish

Lush lettuce

The hatching jar

A tank of tilapia

"In one month we only use 46 cubic metres of water, which is only five per cent of that used in conventional agriculture, and an amount that is only lost through evaporation and evapotranspiration - the evaporation of water through plants," he added.

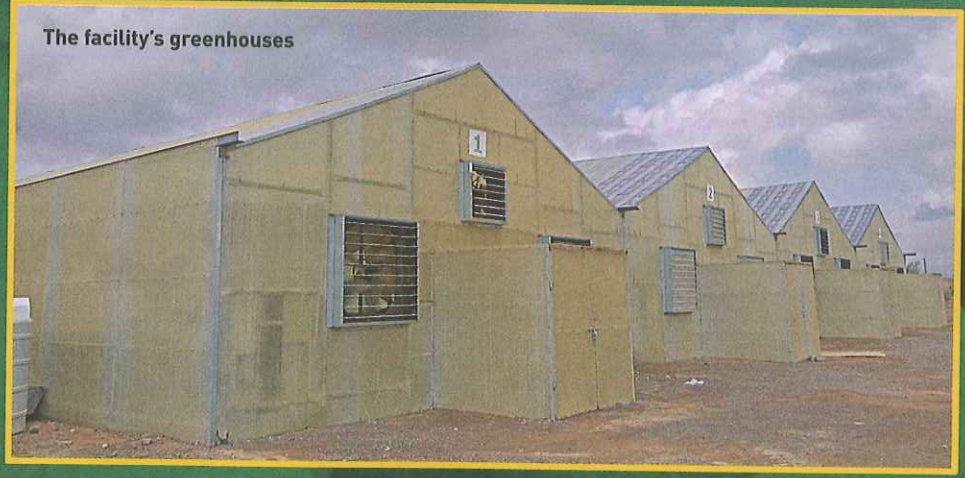
"The filtering process runs throughout the year, 24 hours a day, seven days a week with weekly checks for water quality," added Dr Radhakrishnan, the Research Assistant in Dr Belal's team, which also includes Mamdouh Kawanna, the technician and Dr Eihab Fathelrahman, the team economist.

Currently, the three greenhouses being used for experiments house only lettuce while the fourth one, for demonstrations, is home to a range of produce including eggplants, cucumbers and tomatoes.

This is the first year that experiments are being conducted, and there are two primary ones, both of which began in February. The first is examining the density of lettuce produced while the second is looking into the density of tilapia produced.

Dr Belal is conducting other experiments in the Aquaculture lab to manipulate tilapia feed ingredients using some local ones. The aim is to make the feed cheaper and more sustainable, by replacing some of the imported feed stuff like corn with date and date pips as an example.

"The aim of the experiments then is to measure the difference in production and calculate the economic feasibility for each cubic metre of water and each kilogram of feed," explained Dr Belal.



The facility's greenhouses

Furthermore, he has noted that, on average, one kilogram of fish feed produces 19.2kg of lettuce and 600g of fish, and the average weight of one lettuce is 260g. Meanwhile, each greenhouse spanning 400 square metres with a water surface area of 120 square metres can produce 730kg of lettuce and 45kg of fish per month, when fish are small.

And what is done with the large quantity of produce? "We give it away," replied Dr Belal, adding: "It goes to employees in the university, workers and friends."

While this year is dedicated to the research and growth of lettuce, Dr Belal plans on growing tomatoes next year and cucumbers in 2018. Future plans also include setting up a saltwater aquaponics system – making use of saltwater instead of freshwater – to grow quinoa using seabream.

"Our system is still in its infancy but this is the clear step forward," said Dr Belal, referring to the field of Agriculture, in which he now has close to 30 years of experience, "It's efficient – saves water, produces quickly – and it's organic by the American system.

"This type of sustainable agriculture is especially important in a region like the UAE, where water is scarce and a commodity," he concluded.