More food
Less footprint

Creating an innovative and sustainable agricultural solution for the UAE's green revolution through commercial scale aquaponics

Presentation
October 2025

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1. Introduction

Dr Theo de Jager, President of the World Farmers Organisation:
"The farmers who will succeed in the future are those who can produce the best quality on the smallest space of land with the fewest inputs."

After hosting COP28 in 2023 the UAE is even more than other member states in the sights of all of those targeting the green sustainable revolution.

UAE climate change minister Mariam bint Mohammed Almheiri said The UAE's agricultural industry wants to improve food security and minimise the carbon footprint attached to heavy reliance on food imports.

"During the Year of Sustainability and as the UAE approaches hosting the Cop28 conference, the efforts of the task force represent a pioneering model to enhance food security," Almheiri said. The National Farm Sustainability Initiative (NFSI) task force is a government group set up by the UAE's Ministry of Climate Change and Environment in June.

The first part of the pioneering model is to supply food and agricultural products totalling AED500 million ($136 million) over five years to some of the country's biggest public sector institutions.

The deal aims to help participating entities obtain 50 percent of their total food purchases from local sources by 2024, 70 percent by the end of 2025, and 100 percent by 2030.

As well as to increase purchases of national farm products, the goal is to expand local production and raise the country's self-sufficiency for selected food items, improving the income of Emirati farmers without affecting food trade. (www.agbi.com)

Meanwhile state-owned Emirates Development Bank (EDB) has approved over AED721 million ($196.29 million) in financial support for food security projects since the launch of its new strategy in April 2021.

Bank CEO Ahmed Mohamed Al Naqbi stated investments in agriculture and innovation were needed to boost national food security.

2. The challenges faced by agriculture in the UAE:

Samuel Johnson, author:
"Agriculture not only gives riches to a nation, but the only riches she can call her own."

Image by Julian Hacker from Pixabay

- More than one third of the land is covered with sand.
- The soil quality is very low compared to other countries.
- Heavy winds transfer soil from one region to another.
- Total arable land only 1 600 km^2 out of the total of around 71 000 km^2.
- Most of the arable land is already used to produce dates.
- Rainfall is extremely low.
- Groundwater sources are under great pressure.
- Freshwater availability decreased from 238 trillion litres to only 10 trillion litres between 1969 and 2015.
- Due to huge amounts of groundwater being drawn out saltwater intrusion occurs.
- Treated, desalinated water contains chemicals contaminating the soil. (www.agrifarming.in)

- Meanwhile population growth and tourism are adding to the strain on natural resources.
- The Emirates imports 85% of its food.
- The demand for fresh produce is around 650 thousand tonnes annually.
- The UAE consumes more than 220,000.00 tonnes of fish per year, and it has a seafood consumption per capita of 28.6 kg/year, which is higher than the global average (Food and Agriculture Organization of the United Nations (FAO), 2021).
- The country imports 75% of its annual fish consumption while aquaculture provides 2% of total fish consumption (FAO, 2021).
- There are about a dozen of aquaculture farms registered with the Ministry that produced 3,223.00 tons of fish in 2019, representing one percent of domestic consumption (Ministry of Climate Change and Environment, 2020).

3. What is the good news?

AgriTech can provide the solutions and the AUE is already committed to enabling those solutions.

Food security is one of the five priority sectors that EDB supports to contribute to the UAE's national development and economic diversification plans.

The agritech loans programme provides long-term loans of up to AED5 million to local producers, farmers, agribusinesses, and food-related projects. The bank has already earmarked AED100 million to support the programme.

A joint report from Sharjah Research Technology and Innovation Park and Deep Knowledge Analytics suggests that in 2021 UAE-based companies received $600 million of investments into agtech – 1,1 percent of the global capital invested in the sector.

- Food Technology Valley has been launched.
- Sustainable cities are being planned and developed
- The 'Discover Your Urban Farm' Initiative has been launched:
- As part of its sustainable community engagement program, Sharjah Sustainable City has launched an innovative initiative called 'Discover Your Urban Farm.' The initiative aims to introduce residents to urban farming, enabling them to cultivate their plants or vegetables in 'Agri Pods.'
- Blue Transformation focusing on sustainable aquaculture expansion and intensification,
- effective management of all fisheries and upgraded value chains is being incorporated.

The UAE currently has one of the highest per capita intakes of seafood, equating to around 28 kg per person per year.
In 2015, aquaculture production was 790 tonnes, consisting of gilthead seabream, marine shrimp, tilapia, sturgeon, etc. The major development in aquaculture in UAE in recent years

was the construction of a large scale in-door aquaculture farm equipped with recirculating aquaculture system (RAS) for sturgeon farming, with the target of up to 30 tonnes of caviar production annually in coming years. It is expected that an increasing number of fishermen and private entrepreneurs will be lured into the aquaculture sector in the near future.

All of these goals can be reached by using aquaponics. Aquaponics slots perfectly into plans for sustainable cities and can be deployed from small family size systems to large commercial projects.

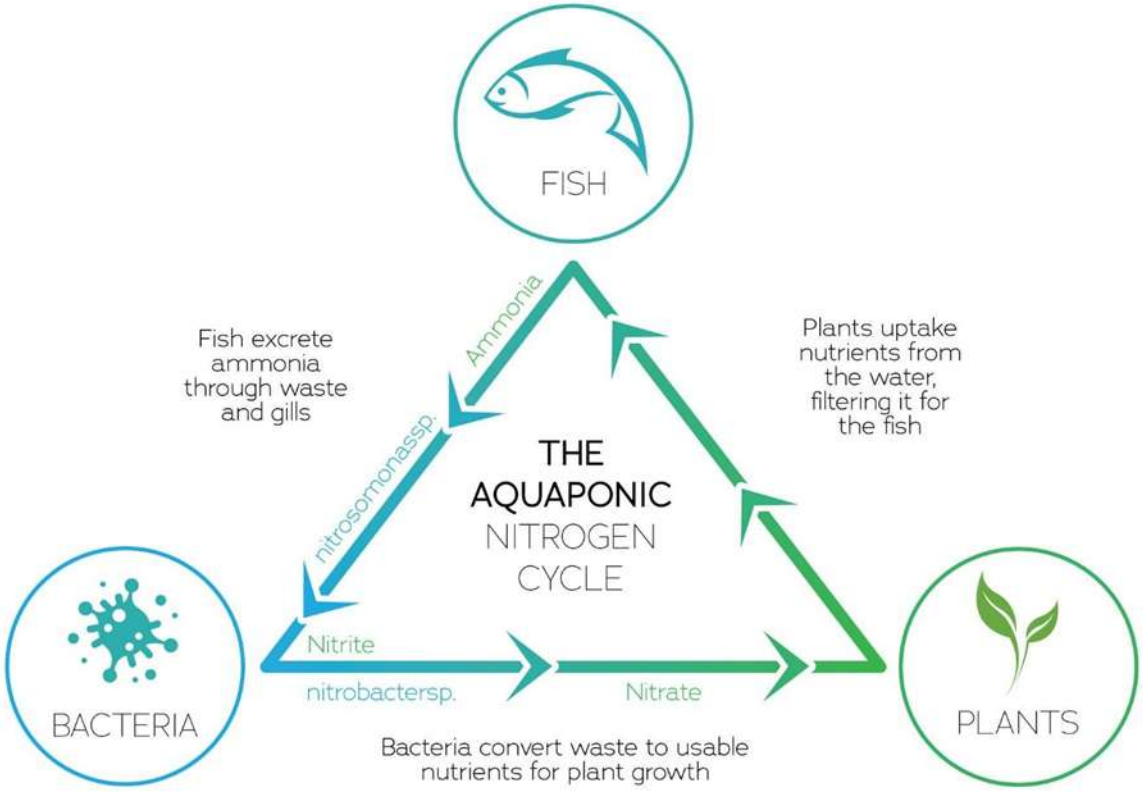
4. What is aquaponics?

- Aquaponics is the combination of aquaculture (fish production) and hydroponics (vegetable production) in a natural ecosystem.
- By circulating the water from the fish through a bacteriological system, as well as removing the solids to be mineralised and returned to the system, the vegetables can enjoy all the benefits of biologically produced nutrients.
- The vegetables, in turn, act as filter for the water returning to the fish. No chemical pesticides or herbicides are used in the system as they would kill the fish.

5. Benefits of aquaponics

- Significant reduction in the usage of water (compared to traditional soil methods of growing plants). Up to 95% less water is used to farm the same crop.

- There is no need to dispose of fish waste or provide an artificial filtration system.
- Significant reduction in land is required to grow the same crops as traditional soil methods.
- It is easier to set up for year-round use compared to traditional growing methods. Grow beds are raised off the ground and growing area is compact allowing for economical “greenhouse” type methods to be employed.
- Many different plants can be grown at the same time.
- Reduced damage from pests and disease.
- Reduced risk from environmental factors.



6. Why the Kleinskuur Aquaponic system?

- Kleinskuur Aquaponics (KSBA) is a South African based company who has developed an aquaponic system that is practical, scalable, and suitable for a variety of climates.
- Kleinskuur means “little barn” in Afrikaans, referring to where the idea was born.
- It is a year-round, proven, modular, working system.
- Design and implementation by KSBA who have tested system designs and efficiencies for the past 8 years. KSBA has established relationships with world leaders in the aquaponic industry (i.e., Dr. James Rakocy, Murray Hallam, etc.)
- The system has been designed to work with and not against nature by:

- tapping into the energy giving power of the sun,
- using gravity and the physical properties of water to enable natural flow and different flow rates for the different parts of the system,
- enabling an aerated nitrification process throughout the aquaponics system to enhance growth rates, plant health, and fish health
- using natural pest control
- incorporating a geothermal system for heating and cooling the water temperature to create ideal living conditions for the fish and the plants.
- avoiding many of the costly and power-hungry add-ons of most modern indoor farming systems, such as grow lights, a multitude of pumps, electronic control mechanisms, measuring and dosing systems, etc.
- learning from and understanding how nature works.

- Kleinskuur systems have been installed and are running successfully in many places, such as the Namibia desert, the sweltering heat of the Zimbabwe lowveld, in cities, in the bush, to the snowy mountains of Lesotho.
- The systems are robust, easy to manage, self-cleaning, ergonomic, safe, and highly productive.
- Compared to other systems the cost of building and maintaining is much lower.
- The Kleinskuur solution has received recognition from the World Economic Forum as an example of a true circulating economy solution in the Five Big Bets for Africa.

"Kleinskuur runs aquaponics farms, provides training, and sells aquaponic systems modified for the continent. The systems use solar energy to pump water for use in a soil-less growing system.

This minimises land and water demand (90% less) and increases resilience to climate change. For large farms, every 6 square meters employs one person."

World Economic Forum: Five Big Bets for the Circular Economy in Africa, p15

7. What does it look like?

There are many different sizes of systems, e.g., KSBA24 (family system), KSBA96 (for lodges and training), KSBA150 (for communities), KSBA1000 (for commercial production) and KSBA4000 (for commercial projects). The KSBA4000 is pictured below.

Every system has three production areas: Fish section, Gravel Barrels for fruiting crops, and Deep Water Culture for leafy crops.

Description of production areas in the KSBA4000:

Fish:
The KSBA4000 has 4 raceway dams, each with a set of net cages for different age groups of fish to maintain constant supply and nutrient levels for plants.
Each dam can contain 29 000 Tilapia in different stages of growth. Harvesting happens by lifting out the net cage to be harvested, without disturbing the rest of the fish. The dam is self-cleaning, and the water never has to be replaced.

Fruiting crops:
The KSBA4000 has 4 000 of the unique patented Kleinskuur Gravel Barrels with Auto Syphon for fruit bearing plants such as tomato, brinjal, pepper, melon, cucumber, etc. The barrels have all the advantages of a single plant bucket system used in hydroponics but was specifically designed to work in aquaponics with its living water environment to encourage aerobic bacteria to release more nutrients for the fruiting crops. If a plant needs to be removed, it does not affect production overall.

Leafy crops:
The KSBA4000 has 74 000 holes in floating trays in a Deep Water Culture system for leafy vegetables such as lettuce, spinach, celery, and kale, as well as herbs such as basil, mint, parsley, rocket etc.
Boards are moved and rotated for harvesting and planting, making it highly productive for workers. There can be a seamless seasonal change of crop types, e.g., while still harvesting spinach one side, lettuce can already be planted on the other side.

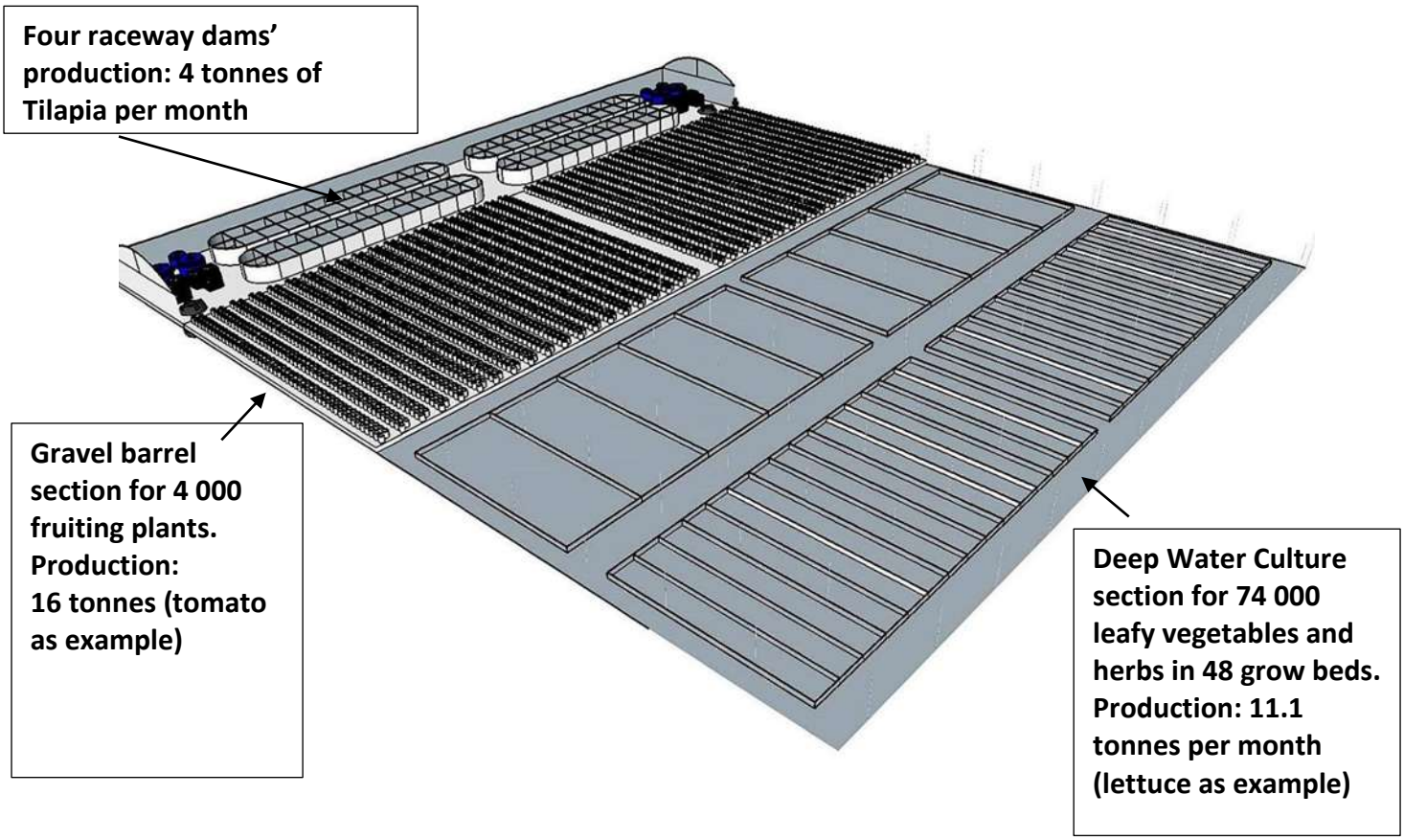
A wide variety of crops can be planted at the same time, whereas hydroponic systems are mono-crop systems, due to plant-specific chemical fertilization mixes. Multi-cropping also means less insect problems.

Photos of some of the Kleinskuur Aquaponic systems and produce:






KSBA4000: Dimensions: 66 m x 72 m = 4 752 m^2



8. Production / hectare

Production space	Systems	Fish/year	Tomato*/year	Lettuce*/year
1 ha	2 X KSBA4000	96 t	384 t	133.2 t
10 ha	20 X KSBA4000	960 t	3 840 t	1332 t
100 ha	200 X KSBA4000	9 600 t	38 400 t	13 320 t

*Tomato and lettuce are just used as known measurable example crops. Many others can be planted.

9. Quick facts

One KSBA4000:
Total water in system: 1 280 000 litres
Daily water use: 5 000 litres
Fish feed: 2 444 kg/month
Power use: 40 kW (with geothermal heating and cooling)
Construction cost: USD120/m^2

10. Proposal

A pilot project should be established in a 5 - 10-hectare area with at least two KSBA4000 units, with a Kleinskuur Aquaponics hatchery to secure the supply of fingerlings, and a complete packhouse and processing facility to add value to the produce harvested.

Technically the systems have been proven, but once economic feasibility had been proven larger projects can be rolled out.

Annemarie Bremner / annemarie@ksba.co.za / +27 82 320 3642
Colin Bremner / colin@ksba.co.za / +27 71 412 4207