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Shady Shaher Elborno
Head of Macro Strategy
ShadyB@emiratesnbd.com

Food Security: Top Priority

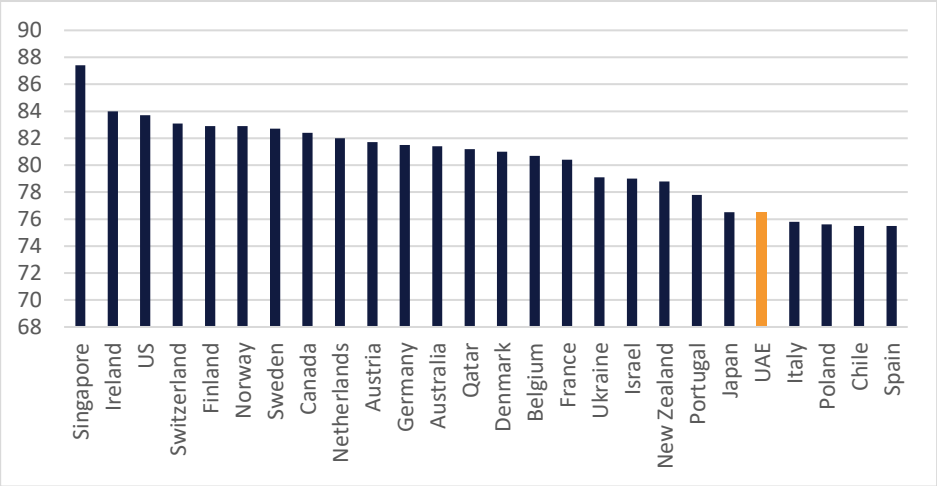
The UAE's food security agenda has taken on a new importance following the start of the COVID-19 crisis, given the pandemic's impact on global food supply chains. The pandemic put into work the Emirates Council for Food Security, a federal entity, given responsibility of ensuring year-round food supply for the nation, especially in the case of a high impact low probability event, such as COVID-19. The council started the National Food Security Strategy 2051 in 2018 with ambitious aims of placing the UAE among the top 10 countries for food security in the Global Food Security Index by 2021, and making it the world's best by 2051. The most recent update to the index (December 2019) showed that the UAE had jumped 10 places to 21st position, with the National Food Security Strategy proving its impact in just over a year

The goal is to achieve zero hunger by ensuring access to safe, nutritious and sufficient food all year-round for the UAE by 2051. This is a challenging target, given the UAE imports about 90% of its food. **The recent events around COVID-19 meant the Council for Food Security had to undertake a very proactive approach** of engaging both soft diplomacy and adopting a dynamic approach to logistics capacities of getting food into the UAE. By any measure the efforts worked well, and the UAE was spared from significant bottlenecks in securing food supplies. The crisis has however sharpened the focus of policy makers on the importance of building a multitier approach to food security, combining elements of soft diplomacy, investments in agribusinesses and agitech, and active supply chain management.

Covid-19 triggered the early warning systems, with active monitoring of strategic food items both inside and outside the UAE, and the council engaging with UAE foodstuff traders on identifying alternative markets in the case of restrictions. More importantly the council worked with its diplomatic missions to support in the case of certain countries placing restrictions.

The UAE approved the National System for Sustainable Agriculture on the 28th of June, which seeks to increase self-sufficiency in targeted agricultural crops, raise average farm income by 10% pa, boost the workforce in the sector by 5% pa and target a 15% pa reduction in water used for irrigation of a production unit.

Global Food Security Index (Top 25 - Overall Scores)



Source: The Economist Group, Emirates NBD Research

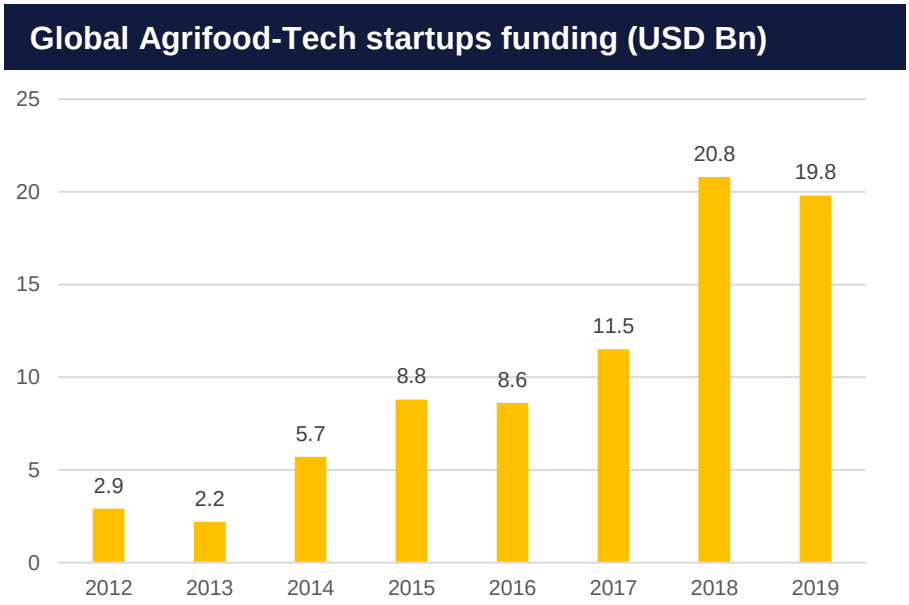
High Tech Farming

With a steadily increasing world population already placing concerns over food supplies and mounting concerns over a global food shortage crisis especially in light of COVID-19, the UAE has been looking at new farming solutions to address food demand in a sustainable manner. **According to the UN Food and Agriculture Organization (FAO), vertical farming consumes 75% less raw material than traditional farming and just 60 watts of power daily to grow 150 kg of vegetables in a month.** The technology uses just 12 liters to produce 1 kg of vegetables against 300-400 liters with traditional farming. Vertical farms also bump up yield and the ability to cultivate commercial varieties of crops in a controlled environment which otherwise would be unsuitable to local climatic conditions. These farms also use artificial light as an alternative to sunlight needed for plant growth.

High-tech farming methods such as hydroponics, aeroponics and aquaponics are critical vertical farming technologies being explored in the UAE. There are a number of other technologies that are being looked at on a parallel level and those include precision agriculture, which focuses on growing conditions for plants using hyperbaric chambers and nanotechnology-based organic nutrition. Photo bio-reactors, which can cultivate food-grade algae such as spirulina. And smart farms, which create harvest plans based on real-time data on food demand and consumption within communities. The UAE has been actively exploring all those technologies that fall under the wider agritech umbrella to enable it to meet its National Food Strategy goals.

Hydroponics

Hydroponics, the process of using a nutrient-rich water solution to sustain plants without the need for soil. The technology is being applied on a mass scale in farms across the world. Growing plants in an environment they are not usually accustomed to eliminate the need for soil and therefore lends hydroponic systems to indoor gardens. Plants grown using the hydroponic method might have their roots suspended in the air and then sprayed with a solution mist, or placed in glass for support and flooded with a solution. NASA has also used hydroponics as part of its projects in creating life-support systems for space stations and in preparing for the potential of colonizing other planets. **Hydroponic farming requires less space and fewer resources. It is a method of growing plants without soil and instead mineral nutrient solutions in water solvent are used.**



Source: AGFUNDER.COM, Emirates NBD Research

One such large scale project in the UAE is being undertaken by vertical farming company **Smart Acres**, which is set to begin operations in the UAE towards the end of 2020. In collaboration with South Korean vertical farming company, **n.thing**, the company designed farm modules using IoT-based technology system to grow and monitor their produce. **The benefits of the system is that it consumes fewer resources and generates ultra-high quality crops**. Successes include cultivating and harvesting mature species of lettuce, with plans to produce a variety of other lettuce and herbs such as Green Glace, Oakleaf, Lollo Rosso, and Shiso, baby spinach, mature spinach, and baby arugula. It will expand to meet the demand of popular produce in the region such as strawberries, with a shift and emphasis on cultivating potato seeds.

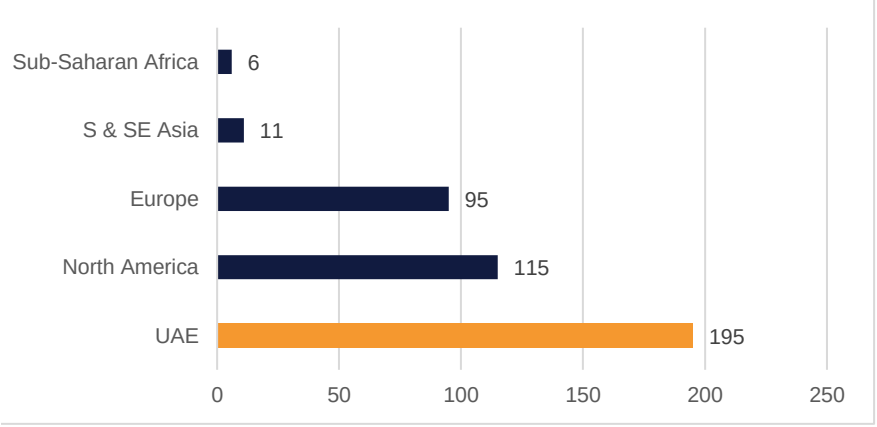
Another area that the company is using the technology for is production of grade-A set of crops that eliminates any pesticides or toxic solutions on the products and has a facility with mandatory anti-contamination air showers for personnel prior to entering, that prevents contamination by unwanted pathogens. The technology is able to detect, track, and adjust the humidity and temperature of the environment in order to maintain the health of the crops. Those crops should be able to withstand the extreme weather conditions of the region allowing for year-round cultivation, harvesting crops 12-fold per year.

Supermarket chain Carrefour has launched a number of in-store hydroponic farms in the UAE. The latest being one in the Carrefour Al-Wasl store that spans 54 square meters and can accommodate up to 16 varieties of leafy greens, including lettuce, arugula, and kale, and herbs such as basil, dill, and sorrel. It joins two other farms in Carrefour locations at Yas Mall and My City Centre Masdar. The farm uses 90% less water and less space than traditional farms to deliver approximately 10kg of fresh herbs and microgreens per day. This equates to the yield of about one acre of farmland.

Emirates Group is gearing up to launch the largest vertical farm in the world as a joint venture between Emirates Flight Catering and US-based Crop One at the cost of USD 40mn (Dh146mn). **Once complete, the facility will cover 12000 sq. meters and have a production output equivalent to 900 acres of farmland**. At full capacity, the farm will produce 2.7 tons of high-quality, herbicide-free, and pesticide-free leafy greens a day using 99% less water than outdoor fields.

In December 2019, **Badia Farms announced plans to build a large-scale high-tech vertical farm in Dubai Industrial City t**hat will produce 3,500 kg of high-quality fruits and vegetables per year. The facility is expected to commence operations this year. The company opened the GCC region's first urban commercial vertical indoor farm in Dubai in early 2018

Per Capita waste of food by consumers (Kg)



Source: UN FAO, Emirates NBD Research

Aquaponics

Aquaponics is a form of agriculture that combines raising fish in tanks with soil-less plant culture (hydroponics). The nutrient-rich water from raising fish provides a natural fertilizer for the plants and the plants help to purify the water for the fish. In normal aquaculture, excretions from the animals being raised can accumulate in the water, increasing toxicity. In an aquaponic system, water from an aquaculture system is fed to a hydroponic system where the by-products are broken down by nitrifying bacteria initially into nitrites and subsequently into nitrates that are utilized by the plants as nutrients. **The water is recirculated back to the aquaculture system.**

In the UAE, Sharjah Research Technology and Innovation Park (SRTIP) has built Merlin Agrotunnel, an aquaponics farm with an area of around 150 square meters that can produce one ton of organic vegetables and fruit per month. **The water that is used to irrigate the fruit and vegetables is seawater, desalinated through solar energy, creating a more sustainable and environmentally friendly production cycle.** The company has been conducting research over the past two years with a team of botanists, agriculturists and engineers from Merlin International to develop a soil-free vertical cultivation technology that is the ideal way to produce sustainable food.

The Agrotunnel can operate in any environment and weather condition – even in the middle of the desert. The tunnel comes with advanced cooling technologies that can work on solar energy and can harvest water from sea or the air. The SRTIP Merlin Agrotunnel can be combined into multiple units to create a commercial farm, or a single unit can be setup in a community to provide fresh organic produce for multiple households daily.

Aeroponics

Aeroponics, a branch of hydroponics, is a farming technology in which the roots are simply hanging in the air, and have 100% oxygen availability. Aeroponics takes place in highly oxygenated environments, which allow for maximum nutrient delivery/intake to the root system. It is an advanced form of hydroponics that makes it possible for farmers to undertake vertical farming solutions that could be customized as per the space configuration and controlled environment of an urban farm. Unlike hydroponics, which uses a liquid nutrient solution as a growing medium and essential minerals to sustain plant growth, or aquaponics, which uses water and fish waste, **aeroponics is conducted without a growing medium**.

One such recent investment in this technology has been by the Abu Dhabi Investment office into AeroFarms, a sustainable indoor agriculture company based in the US. The company uses a patented aeroponic growing system to grow produce. Its focus is next-generation genetic phenotyping and organoleptic research and has a mandate that includes tackling the challenges of desert agriculture from its new 8,200-sq. meters R&D center in Abu Dhabi. The center will be the largest indoor vertical farm of its kind in the world. It plans to employ more than 60 highly skilled engineers, horticulturists and scientists. **The mandate of the center will be research into how to grow crops indoors, including new research in breeding seeds that are optimized for indoor growing conditions.** In the US, Aerofarms works in a series of buildings repurposed for indoor growing—including an abandoned steel factory, an old paintball facility, an abandoned nightclub—but the new R&D facility in the UAE will be designed from scratch. Additionally the company's' R&D center will work with local universities on research projects.

Salt water rice paddies

Chinese scientists at Qingdao Saline-Alkali Tolerant Rice Research and Development Center, **have developed a species of rice that can thrive in the saline and alkaline land.** In the deserts of the UAE for example, where the soil's salt content is high, water absorption of rice plantations will be limited and high alkalinity would cause membranes to form around their roots, effectively suffocating those plantations. Normal rice cannot grow in water containing more than 0.3% salt. Those Chinese scientists have developed a best-performing strain of saltwater rice can grow in water with double that salinity, and that has yielded 9.3 tons per hectare in China.

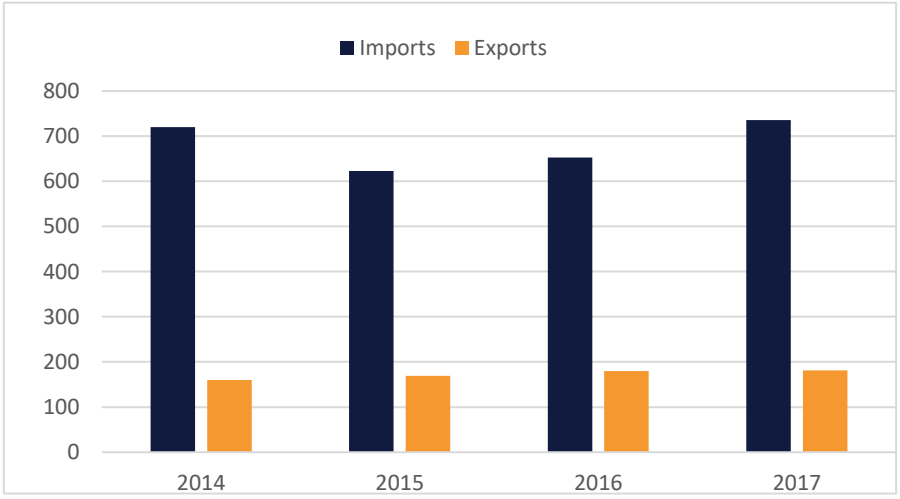
The challenge of desert farming is particularly daunting. Temperatures in the desert can change drastically from day to night, with a difference of as many as 30 degrees. Sand storms happen often and the nutrient-poor soil is too sandy. This is further aggravated by salty seawater just seven to eight meters below the soil. The Chinese scientists at the center have in 2018 manage to successfully grow and harvest rice in the challenging deserts of Dubai, setting up plantations in the desert of the emirate that yield an impressive 7.5 tons per hectare – double the global average. **There are now plans to further expand this experimental plot, with the eventual goal of covering 10% of the United Arab Emirates in paddy fields.**

Aquaculture

Aquaculture, which is the breeding, rearing, and harvesting of fish and other marine life in all forms of water environments represents **a central pillar of the UAE's National Food Security Strategy**. The strategy identifies fish as one of its 18 strategic food items. Launched in November 2018, the National Food Security Strategy was developed to enhance the UAE's food security.

Fish is one of the key sources of protein the UAE focuses on, and the country has invested heavily in aquaculture projects and infrastructure. Aquaculture is considered as one of the most sustainable food production practices to provide seafood meeting 52% of global demand for fish. A challenge the UAE faces is the growing national gap between production and demand. Statistics show that the UAE consumes 220,000 tons of fish a year, 75% of which is imported, while aquaculture provides only 2% of the fish consumed locally. **Per capita, UAE residents eat an average of 25 kg of seafood a year, a fifth higher than the global average.**

UAE International Trade in Fisheries (USD mn)



Source: UN FAO, Emirates NBD Research

In June this year the UAE Minister of State for Food Security Mariam Al Mheiri said the closure of international borders and interruption of food supply chains due to COVID-19 highlighted the importance of developing the aquaculture sector, adding that **it is one of the most efficient food sectors in the UAE, representing an efficient way to grow high-value protein without using large amounts of fresh water,** a precious resource in the UAE.

Attracting private sector investments into Aquaculture is key, with the Food Security minister expecting the Aquaculture sector to become one of the country's "breakout industries". **Aquaculture currently accounts for about half of the world's fish consumption**, and has become the world's fastest growing food producing sector. To date the UAE government has invested more than AED 200mn in hatcheries and fish farms.

The UAE has set up a number of hatcheries that produce fish fingerlings (juvenile fish) from various species. Those hatcheries support aquaculture, promote the sector, and boost national food security. The first type of hatcheries are those within aquafarms. These small hatcheries provide fish fingerlings to advanced, modern aquafarms and are usually considered part of the amenities with Aquafarms. The second is specialized hatcheries, these are larger hatcheries that supply fish fingerlings for environmental and commercial purposes. **The hatcheries, which produce nearly 35mn fingerlings per year in total,** with the Sheikh Khalifa Marine Research Center in Umm Al Quwain having an annual production of 30mn fingerlings, while Aquaculture and Marine Studies Center at Abu Al Abyad island in Abu Dhabi produces 5mn fingerlings.

Key Fish Farms & Aquaculture Companies in the UAE include:

AL JARAF FISHERIES LLC
400 tons of fish and 600 tons of shrimp

- Producing two species of shrimp: Penaeus Indicus (Indian Prawn) and Penaeus Monodon (Giant Tiger Prawn), as well as fish including: Hamour, Sea Bream, and Sea Bass
- In 2009, successfully started the hatchery and grow out of 'Marine Fin Fish'.
- In 2015, RAS Facility for fin fish like Sea Bass, Sea Bream, Barramundi, Hamour and Tilapia.

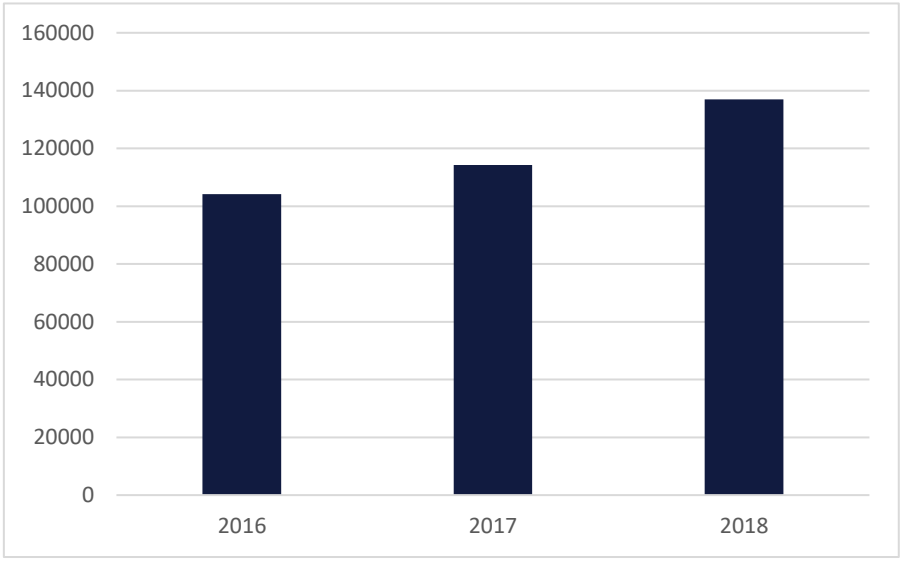
FISH FARMS LLC
3000 tons annually

- Organic Salmon, Organic Hamachi, Organic Sea Bream, Organic Sea Bass, Organic Hamour, Royal Sea Bream, Sea Bass

EMIRATES FISH FARMS OWNED BY ALWATHBA INVESTMENT LLC
120 tons of Hamour Annually

- The Farm comprises of a 120 ton closed environment, bio-secure, recirculating aquaculture system (RAS) Hamour production facility and a marine hatchery capable of year-round production with a capacity of 2mn juveniles per year

Cattle Milk Production in Emirates of Abu Dhabi (Tons)



Source: SCAD, Emirates NBD Research

Dairy Farms

Dairy production in the UAE has its challenges. Severe heat and humidity can be dangerous for dairy cows, lowering milk production and threatening their health and ability to carry calves to term. **Farms in the UAE use special air conditioning systems, shaded walkways, fans and sprayers to help cows cope with the heat.** The two key UAE dairy farms are Al Ain Farm and Al Rawabi Farms, they have specialized air control systems that provide ideal climatic conditions for bovines. Additionally they use advancing tracking technologies that monitor the health of each cow, to prevent heat stress from impacting the quality of milk produced.

Al Ain Farms was founded in 1981 by HH Sheikh Zayed bin Sultan Al Nahyan. It was the first company in the UAE to start dairy operations and provide fresh milk. Al Ain Farms has grown to be the largest integrated local dairy company in the UAE, running four farms under its brand – the dairy business, the juice business, the camel milk production, and the poultry section with fresh chicken and eggs. It produces close to 100,000 liters of milk a day.

Al Rawabi Dairy Company is a Dubai-based company with a wide range of products from milk, yoghurt, laban, and juice. Currently, Al Rawabi operates in the UAE and Oman serving more than 13,000 stores with fresh products. The company started in 1989 with 500 imported cows. Currently at its farm in Al Khawaneej, Al Rawabi has a cattle stock of 13,500 cows.

In a step toward enhancing food security in the UAE, a shipment of 4,500 Holstein cows arrived in the country from Uruguay in July this year. One of the best breeds for milk production, the bovines arrived at the Khalifa Port within 40 days from the date of export from Uruguay. Part of the largest dairy cattle breeding project in the UAE the shipment is the first of the many scheduled ones.

Recent key investments in the food sector

ADQ – Al Dahra

Abu Dhabi investment holding company, ADQ, bought a 50% stake in one of the region's biggest agribusinesses, Al Dahra — which specializes in the cultivation of animal feed and production of rice, flour, fruit and vegetables — and already operates in more than 20 countries. The investment was part of state-controlled ADQ's strategy to support the country's agri-foods sector ecosystem and boost sustainable and diversified food supply in the UAE.

The company is a key player in the UAE food supply sector, with 500 employees, a presence in more than 20 countries, a land bank of 350,000 acres of irrigated land and investments in logistics, to secure inland transportation and sea freight operations. It also owns and operates 15 forage processing and baling facilities globally and cultivates different types of fresh produce, including a wide range of fruit, vegetables and grains with infrastructure to facilitate grains' trading. The company is invested in three flour mills in Greece and Bulgaria, an olive oil production plant in Morocco with an annual production capacity of 10,000 tons, and dairy farms in Serbia and the UAE. While no financial details have been disclosed the investment is an important step in backing one of the key food producers in the UAE

ADIO - AeroFarms, Madar Farms, RNZ and RDI

The Abu Dhabi Investment Office (ADIO) announced that it will invest USD 100 mn in four agritech companies. The four companies will build facilities in Abu Dhabi dedicated to developing next generation agriculture in arid and desert agriculture. In 2019 ADIO launched a program to accelerate the growth of the emirate's agritech sector and promote technology relevant to the local environment and can be exported globally. ADIO has allocated nearly 40% of its AED 1bn agritech incentive program, which is part of the government's Ghadan 21 accelerator initiative.

AeroFarms is a US based sustainable indoor agriculture company. AeroFarms conducts research using a patented aeroponics growing system to grow produce. Its focus is on next-generation genetic phenotyping and organoleptic research. It is also tasked with tackling the challenges of desert agriculture its new 8,200-sq-m facility in Abu Dhabi. The vertical farming center, which is looking to grow its first crops by mid-2021, will employ more than 60 engineers, horticulturists and scientists.

Madar Farms, a home-grown UAE agritech innovator, will build the world's first commercial-scale indoor tomato farm to use only LED lights, located at Khalifa Industrial Zone Abu Dhabi (KIZAD). The company was also set to scale up the commercialization of micro-green growing. This will help provide a consistent and predictable local food supply that responsibly uses the region's natural resources

RDI is developing an irrigation system to transform water usage in UAE agriculture and conducting research trials to increase crop yields in sandy soils and non-arable land. It developed a disruptive irrigation technology that allows plants to self-regulate water and nutrient delivery.

RNZ was established in the UAE since 2004. The company produces fully customized crop specific blends that improve the productivity and value of crops, and exports to South Asia, East Asia, Africa and the MENA region. RNZ will set up an R&D center to research, formulate and commercialize agri-inputs.

Conclusion

Food security occupies a key place in the region's pyramid of security priorities, and that position has been pushed up a few places thanks to COVID-19. The pandemic was the low probability, high impact event that tested the region's food security emergency response systems. As lockdown restrictions ease, and the world still struggles to achieve a clean exit from the pandemic, the lessons for food resource security are ever more apparent. Reducing dependencies is key. As the pandemic showed us, despite food supply agreements being in place, little can happen when planes cannot make it to the skies to ship goods. Furthermore some countries could simply decide that national interests overwhelm international agreements in times of crises. In the hot and arid environment of the region, traditional farming is a very big challenge, however the variety of agritech solutions, are opening up farming opportunities that only a few decades ago seemed impossible. We are now able to grow a wider and wider variety of greens and produce, develop crops that adapt to this environment, and do all that in a very sustainable manner. **The UAE has been very proactive in its response to the challenges, soft diplomacy will always play a key role,** and maintaining relations with key food trading partners is very important especially in periods of crisis.

However there needs to be a complete circular approach towards dealing with the food challenge. One important aspect is food wastage. Annual food waste in the UAE was estimated at 197 kg per person, compared with 95 - 115 kg in Europe and North America. Abu Dhabi's Crown Prince HH Sheikh Mohamed bin Zayed Al Nahyan recently called for end to 'habit of excess' and food waste in UAE. The government has launched a number of awareness campaigns in recent years including #StopTheWaste This is a long term structural social effort that will be needed to mitigate the consumptions side of the food equation. The UAE's Minister of State for Food Security said the UAE aims to reduce food wastage by 50% by the Year 2030, estimating the UAE loses almost AED 13bn annually to food wastage.

Many of the most recent investments in agritech companies in the UAE have included an element of R&D commitment in the region by those companies. This a very welcome step forward, as it engages the academic and research community domestically to work with commercial entities, in building sustainable solutions forward for food security.. Many of the solutions that the region will need to address food security sustainable will depend on the ability to innovate and push forward on agritech solutions. Actively investing in businesses in that sector along with cultivating R&D clusters around this sector will deliver solutions going forward.

Appendix

National Food Strategy: Policy elements

The UAE's National Food Security Strategy 2051 was launched in November 2018, during the UAE's Government's second Annual Meetings. The UAE's Minister of State for Food Security, H.E Mariam Hareb Almheiri, presented the elements of the national food basket, which includes 18 main types, based on 3 main criteria:

- **Consumption:** The volume of domestic consumption of the most important products
- **Production:** Capacity to produce
- **Nutrition:** Processing and nutritional needs

The food security strategy has identified five main pillars of national food security:

- *Facilitating* global agri-business trade and diversify international food sources.
- *Enhancing* sustainable technology-enabled domestic food supply across the value chain
- *Reducing* food loss and waste
- *Sustaining* food safety and improve nutritional intake
- *Enhancing* capacity to respond to food security risks and crises

Also five main enablers of the national strategy:

- Building and effective food security governance model.
- Establishing and implementing a national R&D Food Security agenda
- Developing a National Food Security Database.
- Building human capacity for food security function.
- Engaging the community to shift food consumption Habits.

The 18 main food items are identified under three subcategories:

Plant Products

- **Fruits:** Apples, Bananas, Dates
- **Vegetables:** Leafy Greens, Tomatoes, Potatoes, Cucumber
- **Grains & Pulses:** Pulses, Rice, Wheat, Sugar
- **Other:** Oil

Livestock

- Cattle Meat – Goat Meat – Poultry Meat – Milk – Eggs

Fisheries - Various Fish

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Emirates NBD Research & Treasury Contact List

Emirates NBD Head Office
12thFloor
Baniyas Road, Deira
P.OBox777
Dubai

Aazar Ali Khwaja
Senior Executive Vice President
Global Markets & Treasury
+971 4 609 3000
aazark@emiratersnbd.com

Khatija Haque
Head of Research &
Chief Economist
+9714 230 7803
khatijah@emiratesnbd.com

Research

Edward Bell
Senior Director, Market Economics
+9714 230 7701
edwardpb@emiratesnbd.com

Shady Shaher Elborno
Head of Macro Strategy
+9714 609 3015
shadyb@emiratesnbd.com

Daniel Richards
MENA Economist
+9714 609 3032
danielricha@emiratesnbd.com

Jamal Mattar
Research Analyst
+9714 444 3607
jamaly@emiratesnbd.com

Sales & Structuring

Group Head – Treasury Sales
Tariq Chaudhary
+971 4 230 7777
tariqmc@emiratesnbd.com

Saudi Arabia Sales
Abdulazeez Adm AlSomali
+966 11 282 5623
abdulazeezso@emiratesnbd.com

Singapore Sales
Shivakumar Srinivasan
+65 6578 5620
shivakumars@emiratesnbd.com

London Sales
Carlo de Vos
+44 (0) 207 838 2279
devosc@emiratesnbd.com

Egypt Sales
Ahmad Okasha
+202 2726 5934
aokasha@emiratesnbd.com

India Sales
Ashish Pahuja
+91 22 6813 6202
ashishpa@emiratesnbd.com

Emirates NBD Capital

Hitesh Asarpota
Head of Debt Capital Markets.
+971 50 4529515
asarpotah@emiratesnbd.com

Investor Relations

Patrick Clerkin
+9714 230 7805
patricke@emiratesnbd.com

Group Corporate Affairs

Ibrahim Sowaidan
+9714 609 4113
ibrahims@emiratesnbd.com

Claire Andrea
+9714 609 4143
clairea@emiratesnbd.com