

# Advancing Food Security Through Technology and Innovation

FoodTech Challenge 2020



Knowledge Partner of the  
FoodTech Challenge 2020

  
**accenture**

#### About the UAE Ministry of Climate Change and Environment

The UAE Ministry of Climate Change and Environment was established in 2017 as a strategic office tasked with setting a whole-of-nation plan and strategy to promote and sustainably develop the water and food sectors and generate practical, tech-enabled solutions to address the challenges the UAE faces. The office is responsible for overlooking the implementation of the National Food Security Strategy 2051 and the National Water Security Strategy 2036.

The UAE Ministry of Climate Change and Environment works to establish partnerships with domestic and international stakeholders to promote governance in the food and water sectors, adhere to the latest global visions and trends, and launch integrated projects and initiatives to develop food and water systems in the UAE. This, in turn, empowers the sector to contribute to the national economy and boost its competitiveness now and in the future.

Sustainability is at the core of the Office's strategy, where it strives to ensure optimal use of food and water to preserve natural resources. The Office also works closely with all relevant entities to ensure realization of the food and water security visions and ambitions. The main objective of the office is to ensure that all citizens and residents of the country have access to safe, sufficient, and nutritious food, at affordable prices for an active and healthy lifestyle, including emergencies and crises.

The UAE Ministry of Climate Change and Environment also works in collaboration with international organisations to make sure the UAE meets its obligations towards implementing the Sustainable Development Goals (SDGs) and Agenda 2030.

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#### About Tamkeen

Tamkeen is an Abu Dhabi based company mandated to deliver projects to meet the UAE's vision of knowledge-based development. Tamkeen works with a variety of local and international institutions to enrich the UAE's social, cultural and educational landscape.

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#### About Accenture

Accenture Research creates data driven insights about the most pressing issues global organizations face. Combining innovative research techniques with a deep understanding of industry and technology, our team of 300 researchers in 20 countries publish hundreds of reports, articles and points of view every year. Our thought-provoking research – supported by proprietary data and partnerships with leading organizations, such as MIT and Harvard – helps our clients embrace change, create value, and deliver on the power of technology and human ingenuity.

*Accenture Research is the knowledge partner of the FoodTech Challenge. This report has been researched and authored by Tom Wainwright, Sarah Qian, Tessa Leach and Carla Issa with special thanks to Hans Van Hoof, Jessie Dong and Kathryn Language.*



The UAE National Food Security Strategy allows us not only to develop the entire food system, but also to transform it into a major contributor to the UAE's sustainability. Technology is key for enhancing the sector's sustainability.

We have proven ourselves to be capable of facing any crisis. The COVID-19 pandemic taught us that our success is measured by our ability to provide food under any circumstances and establish an agile work environment that allows all partners to innovate and collaborate towards enhancing food security.

**HE Mariam Almheiri,**  
Minister of Climate Change and Environment



Seeking solutions to the nation's greatest challenges through innovation and technology defines the UAE's forward-looking approach to development and diversification. The FoodTech Challenge is a call to innovators from around the world to develop viable, technology-driven solutions for commercial application in the UAE.

Tamkeen is delighted to have partnered with the UAE's Ministry of Climate Change and Environment to deliver this global search for cutting edge agtech solutions.

**Rima Al Mokarrab,**  
Chair of Tamkeen LLC



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# FOREWORD

Like many countries in the Middle East, the UAE faces several challenges when it comes to creating and maintaining a resilient food system in a part of the world where arable land is limited, water scarcity is rampant and extreme heat is the norm. Being able to meet current and future demands for a high-income country that imports 90 percent of its food takes a concerted effort, one that is enhanced by the numerous technologies available today. The UAE's commitment to improving food security squares technology at the core of its strategy to build resilience and opens new opportunities across its food value chain.

To support its food security goals, the UAE has several initiatives in place and has made measured advancements on them. From testing the resilience of its emergency capabilities during a prolonged period of global disruptions to growing a wide variety of fruit and vegetables far into the Liwa Desert, the UAE is many steps closer to being a more food secure nation. As the Knowledge Partner to Tamkeen and the UAE Ministry of Climate Change and Environment, for the FoodTech Challenge, Accenture is working to drive progress around the value and proven benefits of new and emerging technological solutions to close that gap even further.

The exciting new technologies, business models and platforms we put forward in this publication—including the winning solutions emerging from the latest UAE FoodTech Challenge—call on farmers, scientists, traders and leaders to trade old models and unlock new opportunities.

The solutions presented are having a dramatic impact in difficult environments around the world—promising to increase the volume, quality, reliable production, shelf-life, and affordability of food. There are solutions from supporting the UAE's 'grow local' movement to respecting the cultural and religious traditions that require meat proteins to be halal—and technology is at the core.

For the UAE, the future is promising. Key players are already investing heavily in areas such as precision agriculture, vertical farming, micro-livestock, and dryland farming. With deeper investments in AI and blockchain, technology-enabled food production can not only address in-country needs, but also positions the UAE as an agritech innovator. Leveraging the country's global position as a top trading hub, these technologies can also enhance efficiency in logistics, positively impacting food security. The road toward a more food-secure future will, we believe, be paved by a clear vision and policies that leverage digital capabilities—some of which are only now being launched. With its food security strategy, the UAE has the vision to help pioneer a more abundant future for its people, while being an example for the world.

## Alexandre Bres

Chief Operations Officer, Accenture, Middle East



# INTRODUCTION

The United Arab Emirates (UAE) is a high-income country whose inhabitants enjoy economic and political stability in a region that often lacks both. Like many of its neighbours, the UAE faces a host of issues in both the regular availability of a variety of foods and the resilience of its food system in meeting the demands of a broad range of consumers. This is driven by limited arable land, water scarcity and extreme heat, all of which make domestic food production difficult. Yet, food security has improved in recent years. In 2017, the UAE partnered with the Food and Agriculture Organization (FAO) of the United Nations, cementing a broad five-year agreement that aims to strengthen food security and nutrition, and encourage innovation and technological development in the food and agriculture sectors.

With the COVID-19 pandemic further highlighting the vulnerability of long and complex food supply chains, the UAE is keen to identify new solutions that will help deliver the strategic goals of the National Food Security Strategy 2051 to become a world-leading hub of innovation-driven food security.

Technology and innovation-led solutions can help achieve this vision through strengthening international supply chain resilience, increasing domestic food production, reducing food loss and waste, and driving healthier and more sustainable food choices among consumers. Done well, these technological investments will not only build food security; they will unlock significant economic and social benefits for the UAE.

To catalyse action toward its food security vision, the UAE has launched several initiatives, including the FoodTech Challenge: a global competition that seeks to identify and encourage technologically-driven sustainable food and agriculture innovations. In support of the challenge, this report aims to stimulate discussion on both unique food security opportunities and risks facing the UAE, and how they can be addressed through technological innovation.



This report draws inspiration from the twelve finalists and four winners of the FoodTech Challenge 2020, as well as local and global best practices to assess strengths and vulnerabilities in three key areas for increasing supply chain resilience:

- Accelerating domestic production,
- Trimming food loss and waste, and
- Encouraging healthier food choices—and potential solutions and approaches to address each.

**This report explores the UAE's food security challenges and highlights opportunities that can be unlocked through a technology and innovation-led approach.**



# THE QUEST FOR SUPPLY CHAIN RESILIENCE

## THE UAE NATIONAL FOOD SECURITY STRATEGY 2051

Due to its harsh climate, minimal rainfall, and scarce arable land resulting in low domestic food production, the UAE ranked 42<sup>nd</sup> on the 2020 Global Food Security Index.<sup>1</sup> With a high volume of imports and limited control over supply chain disruptions caused by global shortages, price surges, geopolitics, and other events, the UAE launched its National Food Security Strategy 2051 in 2018.

### What does Food Security mean to the UAE?

As defined by its national strategy, Food Security will enable all citizens and residents to have access to sufficient, safe and nutritious food for an active and healthy life at affordable prices, including during emergencies and crises.<sup>2</sup>

The UAE's National Food Security Strategy 2051 seeks to develop a comprehensive national system to ensure food security in all conditions and stages.<sup>3</sup> The strategy addresses the challenges facing the UAE in four areas:

- Developing a comprehensive national system based on enabling sustainable food production using modern technologies
- Increasing domestic production and diversifying international food sources
- Reducing food loss and waste
- Influencing consumers towards healthier, more sustainable food choices

Technology investment in all these areas can deliver more than just enhanced food security. A carefully considered transformation journey can unlock economic and social advantages, including jobs, health, income from exports, energy cost savings, and reduced greenhouse gas emissions from fuel and food waste.



The pioneering FoodTech Challenge encourages young innovators to use their knowledge and skills to develop technology-enabled solutions to achieve sustainable food security. The grassroots initiative offers the winning entrants a shared prize of US\$ one million and to access a business incubator that can turn their concepts into commercial enterprises.

Essa Abdulrahman AlHashmi, Head of UAE Ministry of Climate Change and Environment



## SUPPLY CHAIN DISRUPTIONS DUE TO COVID-19

In 2020, policies implemented by governments worldwide to contain the COVID-19 pandemic saw business, manufacturing, and other operations restricted or suspended, and movement within and across borders constrained. This disruption had a significant impact on supply chains, which led to price spikes and costly logistics.

The UAE Minister of Climate Change and Environment, HE Mariam Almheiri, noted in September 2020 that the UAE had experienced several supply chain disruptions amid the pandemic, with certain foods not making their way into the country. Red meat imports from India into Dubai dropped nearly 85 percent in April 2020. Other shocks ranged from shortages in cooking oil from Ukraine, lentils from Australia, and sardines from Morocco. With subsequent waves of COVID-19 having the potential to cause further supply chain disruptions, the pandemic put the UAE's crisis management plan to the test and actions were taken to ensure accurate records were kept of food stores, ensuring shelves remained stocked.<sup>4</sup>



**The objective of the FoodTech Challenge is to create a new paradigm of urban food security – one that places innovative food production at the heart of the community. Through fostering unique approaches in home farming, we aim to develop a novel mode of food production and instill stronger understandings of the value of food within society.**

Fatema AlMulla, Project Manager, R&D and Innovation at the UAE Ministry of Climate Change and Environment



## THE FOODTECH CHALLENGE

The FoodTech Challenge was launched in 2019, prior to the disruptions caused by COVID-19, to identify the most innovative agricultural technology solutions for UAE-specific food security challenges. The global competition was established by Tamkeen and the UAE Food & Water Security Office, under the patronage of His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai.

With a US\$1 million prize fund, the FoodTech Challenge was one of the largest competitions launched at the time. The competition attracted 437 submissions from across 68 countries worldwide, with the majority coming from the UAE, USA, Egypt, Canada, Brazil, Netherlands, and Germany. Against a backdrop where global food supply chain resilience was being tested, the submissions represented real hope for pragmatic and actionable solutions.

With a sharp focus on energising youth around careers in foodtech, the competition drew a significant proportion of submissions from students and early-stage startups, with many from world-leading universities such as New York University Abu Dhabi, New York University, University of Oxford, Stanford University MIT, Wageningen University, and University of California Davis among many others. The competition called for submissions of solutions that were enabled by proven technologies, scalable and commercially viable, respected efficient use of natural resources and favoured sustainable means, and above all, addressed a specific UAE food security challenge.

With an overwhelming response to address food production, food distribution and waste management, 19 local and international experts from academia, the private sector, and the government policy sector were called on to review and select 12 finalists from the 437 submissions. Of these, four were then selected as winners having tech-leveraged solutions with the strongest commercial viability, UAE relevance and judicious use of natural resources.

# CONTEXT

## CHALLENGES AND THREATS TO FOOD SECURITY IN THE UAE

Some of the challenges the UAE faces are attributed to its geography and topography. Only 0.5 percent<sup>5</sup> of the UAE’s land mass is arable and total agricultural area has decreased by 3 percent annually over the last 14 years. This is a result of steady desertification and soil degradation due to both natural and man-made causes. The region also experiences water scarcity; groundwater, which makes up 44 percent of all water used, is becoming increasingly scarce, while desalinated water, which accounts for 42 percent of water used, is costly to produce and has other environmental ramifications. The UAE’s geographic location also renders it acutely exposed to climate shocks and the effects of long-term climate change.

As a result, the UAE imports approximately 90 percent of its food. Simultaneously, availability and a demand for a significant quantity of diverse foods in the UAE remains high, driven by several factors, including:

- **Socio-economic status** – with a high GDP per capita, the UAE has robust upper and middle classes with significant demand and purchasing power.
- **Diverse consumption habits of multiple cultures** – there is a diverse expatriate community, with people from over 200 nationalities accounting for approximately 90 percent of the UAE’s population.<sup>6</sup>
- **Market access and food choices** – the Food System Dashboard<sup>7</sup> indicates that the UAE hosts an average number of grocery retailers and supermarkets relative to the population, and that the UAE has an above-average per capita purchase and consumption of imported, processed and ultra-processed foods.

Given this context, how can technology and innovation enable the UAE’s food security strategy?

## STRENGTHENING SUPPLY CHAIN RESILIENCE

The food supply chain has four main segments<sup>8</sup>:

- |                              |                                   |
|------------------------------|-----------------------------------|
| 1. Inputs & Production       | 3. Trading & Retailing            |
| 2. Processing & Distribution | 4. Consumption & Waste Management |

Supply chain resilience refers to a system’s ability to be prepared for unexpected events.<sup>9</sup> The COVID-19 pandemic quickly exposed weaknesses in supply chains around the world, making clear the need for intelligent supply chains that prioritise transparency, anticipate new risks, and enable faster decision-making. Fragile supply chains generally exhibit weaknesses in segments 1 and 4 (inputs & production and consumption & waste management). **This report focuses on three main avenues for improving food supply chain resilience within those two segments (see figure 1):**

Figure 1: Three avenues for improving food supply chain resilience



Every minister of agriculture, every minister that deals with food, is actually dealing with food security. But we were going right to the specifics and ensuring that we’re taking the holistic approach. Because it’s not just about growing food. It’s about nutrition. It’s about strategic storage. It’s about food waste. It’s about having emergency plans in place.

HE Mariam Almheiri, Minister of Climate Change and Environment<sup>10</sup>



# STRENGTHENING SUPPLY CHAIN RESILIENCE: THREE KEY AREAS

## 1 ACCELERATE DOMESTIC PRODUCTION

With the assistance of new technologies, the UAE is equipped to increase its domestic production for local consumption. Producing more food within the UAE's borders will:

- Increase food security
- Enable greater control of food supply
- Reduce the risk of supply chain disruption

### Inputs & Production



Local production will also help mitigate climate risk by reducing the overall energy and materials required for transport.

Current crop yields are modest; however, the UAE Food Security Strategy 2051 domestic production targets include a 30 percent yield improvement from new technology-enabled production and increased production of select strategic food items by 15 percent. The future of agriculture in the UAE will be secured through technology-enabled solutions and new approaches that can help farmers to grow smarter, grow new varieties or use new methods, and grow more sustainably.



## Grow Smarter

Efforts to 'grow smarter' incorporate technologies such as big data, cloud computing and 'Internet of Things' (IoT) into existing agricultural practices to optimise limited resources and improve outcomes, increasing efficiencies and yields, lowering costs and more. Precision agriculture, remote insights, cloud seeding, and smart irrigation are just a few innovations that support efficient production.

### Precision Agriculture

Precision agriculture makes use of modern technologies at every stage of production to ensure that crops and soil receive exactly the level of resources that they need. The use of IoT technologies and drones, at scale, can improve yields and profitability.



### Remote Insights

IoT technologies include sensors embedded in a network of physical objects that constantly relay data – e.g. moisture in soil. Drones can provide aerial views of croplands and livestock. Together, they enable more efficient use of inputs such as fertiliser, pesticides, and energy, reduce waste, particularly of water, and improve decision-making by making data available to farmers in real time.

Data collected from crop yields, soil-mapping, weather, and more can inform decision-making and enable more accurate predictions, as well as dramatically increase productivity and reduce the risk of crop failure. Using remote technology to gather and process this data results in faster response times, reduced transport emissions, and less effort and energy to gather data at scale. IoT, satellite and drone imagery can be employed in complex networks to gather previously unfathomable amounts of detailed data. Big data platforms and applications can process the data to derive insights for farmers, presenting it in real-time on, for example, an interactive dashboard on a personal mobile device. AI and machine learning can spot patterns, recommend actions, and adjust predictions and schedules.



## FOODTECH CHALLENGE COMPETITION FINALIST



Evja Green<sup>11</sup> is a crop monitoring system that uses AI and IoT technologies to minimise water use and maximise farm productivity. ([www.evja.eu](http://www.evja.eu))



**We are excited by the idea of helping farmers to grow more abundant, healthier food with minimum environmental footprint.**

Davide Parisi, CEO and Co-Founder, Evja Green

### Cloud Seeding

The UAE is a pioneer of cloud seeding, which involves flying an aircraft into a cloud that has rain droplets present, then introducing salt flares into the cloud to trigger precipitation. This can increase rainfall by an average of 10 to 15 percent and, in certain conditions, by as much as 30 percent to support viability of outdoor farming. The UAE's cloud seeding programme was initiated in the late 1990s and continues today, with almost 250 missions flown in 2019, and experimentation continuing to be led by the UAE National Center of Meteorology & Seismology.<sup>12</sup>

### Smart Irrigation

Smart irrigation systems are automated systems that adjust watering based on weather conditions. When it rains, the controller limits irrigation volumes, thus reducing unnecessary water use and optimising plant hydration for higher agricultural outputs. As this technology is already well developed, raising awareness among farmers of its benefits and upskilling them in its usage will be the quickest way to increase adoption.

In the UAE, smart irrigation can be of huge benefit, optimising watering schedules to reduce operational costs, promote water conservation and increase farm profits. This will enable expansion of agricultural capabilities, assisting the UAE in becoming more self-sufficient despite water limitations. The next stage of the smart irrigation journey is to implement irrigation scheduling using AI to identify the real-time needs of plants.

### Grow New

New ways of growing and raising food are emerging as technologies advance and research uncovers the potential for nutrition sufficiency in unlikely places. New ways of growing include micro livestock, vertical farming and smart systems and sensors.

### Micro Livestock

Raising traditional livestock requires significant feed, water, and land resources, and is considered by many to be an inefficient converter of resources to food. If not managed well, inefficient practices such as overgrazing can quickly result in deforestation and desertification. Micro livestock farming – the farming of edible insects – offers a solution.

The FAO estimates the insect industry could be worth US\$1.5 billion by 2023, and US\$8 billion by 2029.<sup>13</sup> Edible insects offer high-quality protein and require less land, water, and feed than traditional livestock to produce the same level of protein. While micro livestock farming has been established as an alternative source of protein in some countries, Nigeria<sup>14</sup> for example, where demand for food is growing, adoption remains low in other parts of the world. Low adoption could change if the stigma surrounding micro livestock diminishes. In the short-term, insect protein may help accelerate the UAE's growing aquaculture industry by providing high-nutrition food for fish farms.

## CASE IN POINT

**Protix<sup>15</sup>** uses AI, genetic improvement programs, robotics and other high-tech solutions to produce insects as food on an industrial scale in the Netherlands.

### Vertical Farming

Vertical farming is a controlled-environment form of agriculture. By incorporating smart systems and sensors, including renewable energy, IoT, and intelligent lighting solutions, farmers can reach maximum yields. Locally, these technologies offer an important means to expand domestic food production and have been introduced in recent years. Crops are cultivated on vertically-stacked levels in light, temperature and humidity-controlled buildings, independent of soil and natural sun cycles. This reduces the need to consider seasons, weather conditions, pests or locality. The most important characteristic of vertically-stacked is that it uses 95 percent less water and 75 times less space. Using big data analytics, IoT, machine learning, and simulation modelling, the growing environment in vertical farms can be monitored, tested, reviewed, and improved with predictive analysis.

#### There are four methods used in vertical farming:

- **Hydroponics:** Plants are grown in a nutrient solution free of soil.
- **Aeroponics:** Plants are grown in air with little water and no soil, so the roots are suspended in air and are nourished by misting the root zones with a nutrient solution.
- **Aquaponics:** Fish and plants are raised together, creating a symbiotic relationship between the two ecosystems.
- **Aquageoponics:** An integrated floating cage aquageoponics system,<sup>16</sup> an innovation in fish and vegetable production for shaded ponds.



## CASE IN POINT

**Smart Acres** uses and stores solar energy in parts of the Middle East to run the energy-intensive LED lights needed for vertical farming. This may provide the blueprint for a sustainable 'closed-loop' system for the UAE.

**Badia Farms**, the UAE's first vertical farm, operates commercial vertical indoor farms in the GCC region and uses hydroponic technology to produce leafy green vegetables.

**Madar Farms** operates enclosed and controlled systems that provide optimal growing conditions and protect plants from external weather factors, allowing continuous and consistent food supply year-round. Madar uses both hydroponics and vertical farming methods to unlock the synergistic benefits of both.

**Crop One Holdings** is a US-based company that entered a joint venture with Emirates Flight Catering in 2018 to build a hydroponic farm in Dubai. The two companies agreed to invest US\$40 million<sup>17</sup> in the enterprise that will supply in-flight meals.

**AeroFarms** is a US-based company preparing to build a 90,000 square foot R&D indoor vertical farm in Abu Dhabi – the world's largest – as part of the US\$100million agtech investment by Abu Dhabi Investment Office (ADIO).

# JFCO

FOODTECH CHALLENGE COMPETITION FINALIST



Jones Food Company is an automated sustainable vertical farm driven by AI. ([www.jonesfoodcompany.co.uk](http://www.jonesfoodcompany.co.uk))



Jones Food Company is so exciting because we bring this technology – and its huge potential – to the masses, by constructing farms at affordable prices not only for builders but also for the end customer. We believe we are unique in the vertical farming industry in this regard.

Will Parry, Director of Special Projects, Jones Food Company

## Grow More Sustainably

While the UAE faces several challenges in terms of growing food, including an arid environment and limited fresh water, there are opportunities to embrace new or revert to largely forgotten techniques that leverage opportunities in the natural environment. Smart wastewater treatment, dryland farming, and regenerative agriculture are three such methods.

### Smart Wastewater Treatment

With limited access to surface water resources in the UAE, desalination processes provide most of the country's potable water. However, desalination requires 10 times more energy to produce and transport than naturally available surface water. In addition, dumping brine from desalination into the ocean can lead to ocean degradation. The UAE Water Security Strategy 2036 was drafted to drive sustainability in this area and encourage smarter wastewater treatment for more efficient reuse of freshwater.

### Dryland Farming

In the UAE, arid conditions have resulted in increased desertification and loss of farmland. Unlike traditional agriculture, dryland farming can better cope with weather extremes. It emphasises retaining precipitation on the land, reducing evaporation from the soil surface, and using crops with drought resistance that fit precipitation patterns. This will support the UAE's efforts to encourage sustainable farming and afforestation. Technologies that can improve success, efficiency and sustainability of these methods include IoT and data analytics for data-driven drip irrigation, IoT for circular water use in manufacturing, genetic modification to create salt-tolerant crops and desalination technologies.

## CASE IN POINT

**Netafim**,<sup>18</sup> an Israeli manufacturer of irrigation equipment, is piloting rice growing using drip irrigation in the UAE.

**A team of scientists from China**<sup>19</sup> has grown salt-resistant rice near Dubai using diluted sea water. Eventually, the goal is to cover around 10 percent of the UAE with paddy fields.



## Regenerative Agriculture

With little arable land, regenerative efforts will be needed to expand traditional agriculture. Regenerative agriculture is a conservation and rehabilitation approach to food and farming systems. It focuses on topsoil regeneration, increasing biodiversity, improving water cycles, increasing climate change resistance and generally strengthening farm soil health.

Regenerative agriculture methods include conservation tillage, which advocates low or no tilling, diversifying crops to ensure microbes feed off a variety of carbohydrates to create nutrient-dense soil, rotating crop types planted, and reducing misapplication of fertilisers and soil amendments. In the UAE, there is also a major push toward “soilisation”: creating high-quality soil for planting crops in the desert.



RED SEA FARMS

FOODTECH CHALLENGE COMPETITION WINNER



Red Sea Farms<sup>20</sup> is reducing the carbon and water footprint of our food sector by developing and delivering environmentally sustainable saltwater-based agricultural systems. The company builds new saltwater greenhouses and retrofits existing greenhouses with its patent-pending saltwater-cooling and Coretex control system technologies. ([www.redseafarms.com](http://www.redseafarms.com))



**This win has become a launchpad for Red Sea Farms' expansion into the UAE, providing strong third-party validation around our potential for impact. Being among the winners of the FoodTech Challenge has allowed us to accelerate client conversations in the public and private sector, with the ultimate shared goal of helping the UAE to achieve its food security goals in a sustainable and economically viable way. We are excited to be a part of the UAE agritech ecosystem, and to be among other companies and individuals that are collectively working together for tech-enabled food security and sustainability.**

Ryan Lefers, CEO and Co-Founder, Red Sea Farms

## CASE IN POINT

**Mawarid Holding and Chongqing Earthskin Eco-technology**<sup>21</sup> are implementing desert soilisation technologies in the UAE's Al Ain desert.



## 2 TRIM FOOD LOSS AND WASTE

The UAE's food supply would be inherently more secure if food loss (losses in transportation or storage) and food waste (food that is not consumed and discarded in grocery stores, hotels, households, etc.) could be reduced or repurposed. With a high level of food waste per capita (197 kg per person per year versus 95 to 115 kg in Europe and North America), costing \$3.54 billion each year, the UAE's National Food Security Strategy 2051 aims to decrease food waste by 15 percent by 2021.<sup>22</sup>

Circular agriculture and conscious consumption are several technologies and approaches that can help drive loss and waste down across the UAE domestic supply.



### Circular Agriculture

Circular agriculture, also known as low-external-input farming,<sup>23</sup> aims to produce enough food without use of inputs such as artificial fertilisers and pesticides, and to reduce as much waste as possible. The goal is to use only what is strictly necessary in terms of land and resources, closing resource loops.<sup>24</sup> For instance, waste is used within the cycle (as fertiliser or feed) or to produce new valuable products, thereby closing resource loops.<sup>25</sup> Circular marketplaces, designing out waste, preventing spoilage, and upcycling are several approaches to reducing waste.

### Circular Marketplaces

In a circular marketplace, over-supply is joined up with excess demand, and re-use is promoted through online platforms and communities, ensuring products and materials are continuously circulated for as long as possible and waste is avoided. The UAE can provide support by promoting collaboration among stakeholders, such as between arable and livestock farming, promoting better use of animal manure, and lowering use of artificial fertiliser. The Netherlands, for example, has committed to halving food waste by 2030, and to repurpose whatever remains in the food cycle. Biofuel is another useful way to divert food waste into a diesel alternative or using it for ethanol or other biogas production.

### CASE IN POINT

**Karma**,<sup>26</sup> the Swedish surplus food-selling app, is placing a Smart Fridge into train stations. It helps Swedish restaurants and supermarkets sell their surplus food (meals they would otherwise simply have thrown away at the end of the day) through the app.

**RNG Energy's**<sup>27</sup> joint venture with Philadelphia Energy Solutions resulted in the construction of a digester that converts 1,100 tonnes of food waste a day to renewable methane. It uses produce that is no longer consumer-viable which would have otherwise been disregarded by grocers, restaurants, and institutional kitchens.



### FOODTECH CHALLENGE COMPETITION FINALIST



Whole Surplus is a food surplus management system that connects businesses with resources to reduce their food waste. It offers a holistic surplus management system and creates financial benefits for its partners while helping society and the environment. The business model allows different types of organisations to be involved in the partner ecosystem and turn linear food systems into circular ones. ([www.wholesurplus.com](http://www.wholesurplus.com))



**Creating social and environmental value out of surplus food is the biggest motivation for the team. All of the members work with the mindset to value those foods with the highest benefits.**

Olcay Silahli, CEO and Co-Founder, Whole Surplus

### Designing-Out Waste

In a circular economy, growth is decoupled from the consumption of scarce resources, and waste is "designed out" entirely.<sup>28</sup> Products and materials are kept in productive use for as long as possible and, when they reach end-of-use, they are effectively cycled back into the system. Circular operations are supported by a growing movement in industry and government, by 4IR technologies, such as AI and robotics, and by innovation in every part of the value chain.

### Preventing Spoilage

Food packing can also play a big role in preventing food spoilage. Food preservation is being improved through freeze/spray drying and using natural preservatives such as essential oils<sup>29</sup> to prevent food contamination or deterioration. Other shelf-life extenders include heat and chemical usage, modified product atmosphere, product irradiation, product packaging, and genetic modification. Sustainable packaging also supports reduction in single-use waste while providing adequate food protection.



## FOODTECH CHALLENGE COMPETITION FINALIST



Everfresh Biocoating Technology provides nature-based edible food coating to extend shelf-life and reduce food waste. Everfresh's technology uses a sprayable chitosan-based formulation, which provides a protective, edible coating for agriculture produce while recycling seafood waste.



**The fact we can reduce food waste and protect agriculture produce while recycling seafood waste is a win-win situation from a sustainable and economic point of view, especially during the current COVID-19 pandemic, when the food security and nutrition of millions of people around the world are affected. In Everfresh, we believe that now more than ever, it is important to join efforts using science alongside nature to secure food supply and minimise food loss and waste. We are excited to start doing our part to make this world a better place, where there is more food for everyone and less waste. A better place for the present and future generations and for the environment.**

Mohamed Mannaa, CEO and Co-Founder, Everfresh Biocoating Technology

## More Efficient Logistics

Food that does not comply with import and export protocols cannot reach its intended destination and is often wasted. Sometimes the food fails quality inspections, but other times, high-quality food cannot be transported across borders due to insufficient paperwork or other procedural glitches. Delays of these shipments often result in spoilage and wastage. Improved food compliance and traceability technologies are helping facilitate logistics. Monitoring, certifications and inspections can now be managed digitally, reducing errors and resulting waste.



## FOODTECH CHALLENGE WINNER QS MONITOR



QS Monitor offers a web-based platform that makes it easier to apply for and receive any certificate that might be required for food companies anywhere in the world. The online food safety and traceability platform, currently implemented in the UAE, helps traders to meet UAE regulatory and quality standards, making it easy to streamline imports into the country. ([www.qsmonitor.com](http://www.qsmonitor.com))



**I believe our platform contributes significantly to helping the UAE achieve its food security goals. QS Monitor operates in over 50 countries that the UAE imports foods from. These companies account for approximately 87 percent of UAE imports. Our platform not only decreases the time and cost of trade, it also captures critical data that can improve the quality and volume of safe, good-quality products from the food suppliers of the UAE. We are committed to helping the UAE create an ecosystem where all stakeholders will benefit, gaining access to sustainable, safe, and nutritious food at all times.**

Burak Karapinar, Managing Director, QS Monitor



### Upcycling (Manufacturer, Supermarkets)

Upcycling foodstuffs, using ingredients that otherwise would not have gone to human consumption, can create new revenue streams and contribute to diversion of food waste in the UAE. In 2019, Future Market Insights<sup>30</sup> estimated that the upcycled food industry was worth more than US\$46 billion, with a predicted 5 percent CAGR. For example, a major producer of condiments sells a special ketchup that uses 2.5 million green tomatoes (10 percent of the harvest) that would otherwise go to the landfill.<sup>31</sup>

### Conscious Consumption

As consumption grows, more waste is being generated from household food purchases or from the production of processed foods. Making healthier choices and inspiring a shift in mindset towards healthy food consumption are two ways that aid in the reduction of food waste.

Various apps and new technologies are being developed, including food tracking, nutrition education, meal planning, and distribution of information at the supermarket level to help drive changes in habits.



### CASE IN POINT

- **Kitche**<sup>32</sup> is an app that scans receipts then designs recipe plans based on what the user bought.
- **Flashfood by Hy-Vee**<sup>33</sup> (US) enables consumers to browse and buy food items nearing their “best before” date at reduced prices. Flashfood has partnered with five grocery retailers to divert more than 100,000 units of food.
- **Meal Prep Mate**<sup>34</sup> offers tools to plan, shop, cook, and portion up to five days’ worth of meals at a time. The website allows you to choose pre-designed plans or build your own.



# 3 CHOOSE HEALTHIER OPTIONS

Plant-based diets can increase the volume of food produced and are kinder to the environment than animal farming alternatives. Making healthy choices easy and inspiring a shift in mindset can help limit strain on the supply chain, and support improvements in diets and overall health.

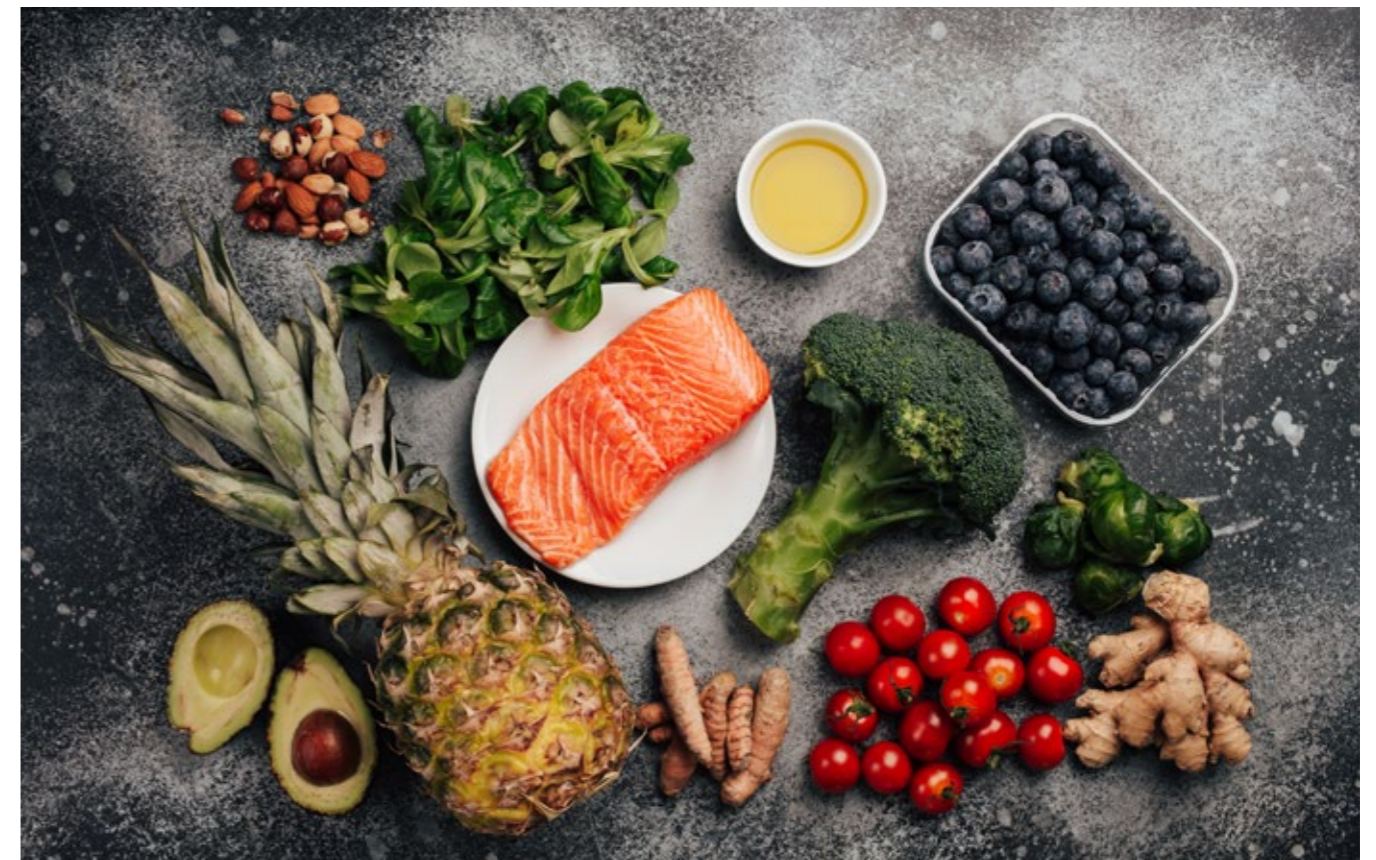


## Make Healthy Food the Easiest Choice

The UAE has one of the highest rates of obesity and diabetes in the world.<sup>35</sup> Therefore, producing and distributing nutrient-dense foods should be paired with education and behavioural nudges. To shift consumer behaviour and improve nutritional intake, the government should engage the community and individuals. Survey data shows that the COVID-19 pandemic has resulted in people making more health-conscious food choices and cooking at home more frequently.<sup>36</sup>

### Alternative Protein

Raising livestock for food requires about 80 percent of the world's agricultural land, yet it produces less than 18 percent of the world's calories.<sup>37</sup> Furthermore, studies have concluded that converting to plant-based diets that replace sugars and red meats with alternatives has the potential to prevent 11 million deaths per year, as approximately 24 percent of adult deaths are attributed to diet-related disease mortality.<sup>38</sup>



The US\$9 billion<sup>39</sup> plant-based protein market in the US is projected to grow to US\$14.32 billion by 2025.

As the world becomes more educated on both the health and ethical implications of animal-based proteins, the plant-based protein market is growing. The US\$9 billion<sup>40</sup> alternative protein industry is projected to grow to US\$14.32 billion in the US by 2025. Lab grown meats were approved for sale<sup>41</sup> by the Singapore Food Agency in December 2020. This is the first time cultured meat has been cleared for sale globally.

Interest in plant-based proteins in the UAE has been steadily growing over the past decade. In the Middle East, leaders and public figures are already investing in and promoting plant-based proteins. As an alternative protein source, plant-based proteins are accessible via traditional foods such as tofu and tempeh, as well as in more processed isolates derived from soy, rice, beans, and peas that are used in supplements such as protein powders. Other plant-based proteins include wheat-based Seitan and soy-based textured vegetable protein. The latest developments also include cellular agriculture, growing animal cells and tissues in bioreactors to form lab-grown 'meat'. It will be important to be able to verify the halal status of lab-grown meat to facilitate cultural and community attitudes.



# HAS ALGAE



**FOODTECH CHALLENGE WINNER**

With their microalgae superfood, Has Algae aims to alleviate common nutritional deficiencies, especially a lack of omega-3 fatty acids, associated with plant-based diets. Has Algae want earth-conscious global citizens to be able to reduce or eliminate meat in their diets without facing limitations. ([www.hasalgae.com](http://www.hasalgae.com))



**Our vision at Has Algae is to deliver sustainable and pure nutrition for the world. I have no doubt that Has Algae's core capabilities and our versatile microalgae can help the UAE meet its future food security needs. This win has also provided a boost for our business—with the support of the UAE government, we have been able to rapidly scale up business activities despite the uncertainties that COVID-19 has brought. That's a win for everyone.**

Brendan Fu, COO and Co-Founder, Has Algae

## Inspire a Shift in Mindset

To change consumer behaviour in the UAE, encouraging the adoption of healthier food habits, behavioural nudging and education with social media influence, may prove effective. New ideas and behaviours can take decades to reach critical mass, but the rate of adoption can increase significantly when prompted by events such as a global pandemic.<sup>42</sup> Research indicates that as a result of the COVID-19 pandemic, 85 percent of Middle Eastern consumers say they are more focused on taking care of their physical health and fitness.<sup>43</sup>

**In the UAE, consumer behaviour is highly motivated by trust and personal relationships.**

To embed change, it will be important to capitalise on these trends with sustained behavioural nudges. In the UAE, consumer behaviour is highly motivated by trust and personal relationships. Brand relationships are important, and for many people, they are created online. Solutions that are likely to drive behaviour changes thus include in-store experiences, gamification and apps that offer personalised nutrition, social media integration - such as relatable brand ambassadors, as well as rewards and discount programmes.<sup>44</sup>



## Gamification and Apps

The use of social media and fun, engaging experiences can make it easier to eat healthier. A 2019 study found that gamification was effective in improving the long-term health of obese children.<sup>45</sup> In addition, seeing others eat healthy food has been shown<sup>46</sup> to increase healthy food choices.

## GLOBAL CASE STUDIES

- **Kalekam**<sup>47</sup> combines the sociability of Instagram and Snapchat with gamification to get people to eat healthier. Rather than the rigid numbers of calorie-counting apps, KaleKam uses AI to recognise foods based on pictures and assess their health benefits.
- **mDiet**<sup>48</sup> is an app-based subscription service that gives a personalised meal plan and grocery list designed by clinical experts. It teaches users new habits with a seven-day repeated meal plan.
- **Berrycartt**<sup>49</sup> rewards users for eating well with discount offers. The rewards are themselves healthy food products, and the intention is to create a healthy eating cycle.

# FINAL THOUGHTS

## UAE INVESTMENTS IN FOOD TECHNOLOGY CAN UNLOCK POTENTIAL VALUE BEYOND FOOD SECURITY

There are exciting opportunities to reposition the UAE as not just a global food hub, but an agritech innovator and even a produce exporter. The example of the Netherlands – a small country with high labour costs that has become a major global food exporter – offers an enticing view of the possibilities. Investment in domestic production will catalyse advances in other areas as new business models emerge to take advantage of the new e-commerce channels and services, and increasingly 'direct to consumer' supply chains.



Of interest for citizens, policymakers, and investors is the potential for new employment and growth, and the opportunity for the UAE, with its significant resources and ambition, to blaze a trail in a rapidly expanding market. New technology will require that new skills, such as machine programming, climate risk modelling, and data analytics, are gained and applied across the value chain. In addition, new roles like drone pilots and behavioural scientists will emerge.

As the UAE's strategies progress, demand will grow for an entirely new workforce able to mobilise and manage an increase in domestic food production – a workforce able to take advantage of new agricultural land or the previously unfarmable swathes of the country, now accessible via new urban and vertical farming techniques.


However, to keep pace with and deliver on the potential of the technological changes, this transition must be carefully planned. It will require strategic coordinated operation of all the levers available to both government and the private sector.



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