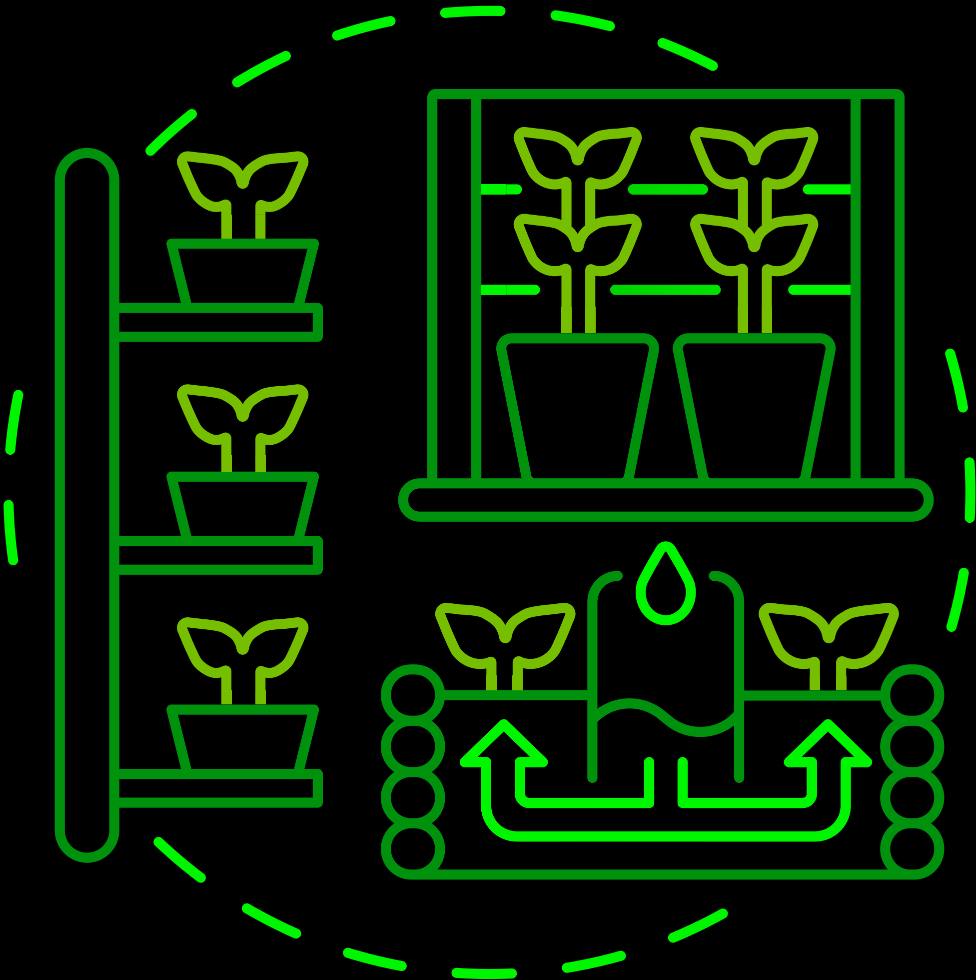
Deloitte.
Private

URBAN
AGRITECHS



The innovative look at vertical farming

Redefining the architecture of agriculture

مئة عام
100 Years in the Middle East

The imperative

The global food system is under mounting strain: by 2050, over 9 billion people - mostly in cities - will demand 25–70% more food,[1] yet conventional agriculture is already degrading soils, exhausting water, driving deforestation and producing up to a third of global greenhouse gas emissions. With shrinking arable land, rising waste, climate shocks, labor shortages and inequities in access, current practices are unsustainable – requiring 1.7 Earths to meet today's needs.[2] Without urgent innovation in resilient, efficient and localized production models, food insecurity, environmental damage and health risks will escalate, making systemic transformation imperative.

Promises

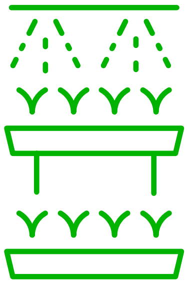
Vertical farming (VF) was heralded as the solution to the vulnerabilities of open-field and greenhouse agriculture, promising year-round, pesticide-free, resource-efficient production close to urban centers with enhanced quality and reduced transport emissions. It was meant to address food security, health and sustainability concerns while offering resilience against climate and supply shocks. Yet in practice, commercialization has repeatedly failed: companies like Infarm, Bowery, Freight Farms and Plenty have collapsed under the weight of massive capital and operating costs, especially electricity and logistics. Instead of delivering localized, scalable solutions, most ventures pursued large-scale models that proved economically unsustainable, leaving vertical farming's grand promises largely unfulfilled.

The problem

Today's food-system architecture is built around the immovable assumption of land-based farm: large contiguous farmland, exposure to sunlight and rainfall, soil-bound nutrient cycles, climate-driven seasonality, and geographic distance from consumption centers. Every component of the system – transport corridors, cold-chain infrastructure, wholesale markets, storage requirements, procurement models, risk management structures, zoning regimes, and even retail rhythms – was designed as a response to these spatial, biophysical, logistical, economic and governance constraints. Current deployments treat vertical farming as a technological drop-in for the cultivation stage while leaving the rest of the city's food system architecture unchanged. This creates a structural misfit: vertical farms are enclosed, location-flexible production nodes that remove traditional constraints of land, seasonality and irrigation, yet the supporting infrastructure (processing, aggregation, logistics, utilities, zoning and real-estate programing) remains optimized for horizontal, climate-dependent agriculture. We have been replacing the farm but kept the legacy architecture that existed solely to accommodate its limitations.

+9 billion people

will demand 25–70% more food by 2050



Vertical farming (VF) was heralded as the solution to the vulnerabilities of open-field and greenhouse agriculture

Redefining the architecture of agriculture

Vertical farming detaches from these inherited constraints, enabling production to be fully integrated into the urban fabric with high predictability, minimal environmental exposure, and radically higher control over inputs and outputs. Production no longer depends on:

- Rural or peri-urban land parcels
- Natural sunlight or seasonality
- Irrigation cycles or rainfall patterns
- Soil fertility and regeneration
- Exposure to weather, pests, and climatic variability
- Long-haul transport and fragile cold chains

To unlock the resilience, land-use and proximity benefits of vertical farming – and to manage trade-offs such as energy intensity and crop scope – cities, investors and developers must shift from "farm substitution" to intentional redesign of food-system architecture, with measurable metrics for environmental impact, cost and resilience.

Instead of inserting VF into a supply chain and policy governance designed for the limitations of conventional agriculture, we adjust those other elements to the advantages and characteristics of VF. This will let municipalities capture the full resilience and efficiency benefits of urban, climate-controlled cultivation.

Pilots

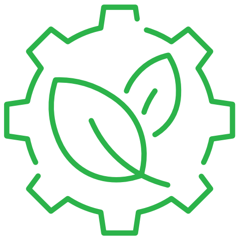
Urban Agritechs envisions the integration of VF as a feature of buildings and a communal component of real estate offers.

Rather than positioning vertical farms as standalone commercial ventures – often hindered by scalability and financial viability – we explore embedding food production into buildings as a shared utility. This is a real-estate symbiosis, connecting neighbors to the source of their food and catalyzing a new era of hyper-localized supply chains, zero-mile retail delivery, and regenerative urban planning.

In this version of the future, municipalities and planning authorities mandate that a minimum percentage of built-up area in residential developments be allocated to vertical farming infrastructure.

Urban farming is not just a technological innovation but a transformative redefinition of urban food-system architecture, unlocking resilience, sustainability, and localized production. Seeing this technology firsthand reveals its remarkable potential to redefine urban agriculture and exemplify how sustainable, localized food production can transform our cities and secure our future.

Daniel Gribbin – Director, Strategy & Transactions, Deloitte Middle East



Urban Agritechs envisions the integration of VF as a feature of buildings and a communal component of real estate offers

This is a real-estate symbiosis, connecting neighbors to the source of their food and catalyzing a new era of hyper-localized supply chains, zero-mile retail delivery, and regenerative urban planning

Dimensions to explore

This is a paradigm shift. Urban Agritechs is piloting the UAE to roll out a series of real estate-embedded community farms over the course of the next year. Urban Agritechs and Deloitte Middle East are exploring this reimagination of the food-system architecture along the following lines:

1. Urban infrastructure

The share of gross floor area that would meaningfully replace traditional farming to cover reasonable dietary needs of citizens. Integrating VF within buildings (residential, mixed-use, commercial) converts a small percentage (preliminary estimation of 5%-10%) of spatial envelopes into productive areas. Like parking, utilities and district cooling, VF can become a building-integrated infrastructure layer that enhances asset performance and supports urban sustainability mandates.

2. Food security

Stable, localized production within cities reduces exposure to external disruptions, serving as a resilience asset for leafy greens and herbs, roots (such as potatoes), and pulses (legumes)—food categories that constitute a meaningful share of dietary intake (about 20% by weight of the average person's diet) as well as import expenditure.

VF adds a stable, controllable production node to the urban food system architecture, with a definite input dependency horizon, IDH, preliminary estimated at 30–90 days. Within this window, it provides disruption-resilient output that conventional agriculture can't match. Therefore, the relevant planning variable is not independence but controlled dependency and buffer duration.

3. Sustainability

Vertical farming offers clear sustainability advantages by reducing food waste, shortening supply chains and preserving the nutritional quality of fruits and vegetables. By producing closer to consumers in controlled environments, vertical farms minimize spoilage, eliminate pesticide use, and drastically cut water consumption – up to 95% compared with traditional farming. They also allow for nutrient tailoring of crops and recycling of waste streams, turning bio-waste into fertilizers or biofuels. These features directly address the UN's Sustainable Development Goals on reducing food loss and improving food security.

The trade-off, however, lies in energy use: vertical farms dramatically reduce land and water requirements but rely heavily on electricity, making their carbon footprint dependent on the energy source. If powered by fossil fuels, emissions rise; if powered by renewables, the footprint can shrink by orders of magnitude. This tension highlights the need for systemic improvements – such as renewable energy adoption, LED efficiency gains, insulation, smart grid integration and reusing waste heat.

Ultimately, the sustainability of vertical farming depends on balancing finite resources (land and water) against abundant but carbon-intensive electricity. With careful design – closed-loop systems, green energy and localized production – vertical farms can alleviate food insecurity and environmental pressures while reducing waste and emissions. The challenge is not the concept itself but ensuring that its energy demands are met sustainably, so the benefits outweigh the trade-offs.

> New approaches to integrating food production into urban life can't just create food security benefits, but also unlock economic opportunities in an otherwise static built environment, reduce food fragility for low income families, and help build micro-communities. Municipalities have a great opportunity to tap into these myriad benefits by rethinking their approach to urban farming
>
> Laura Jepson – Partner, Monitor Deloitte, Deloitte Middle East

An Open invitation

Urban Agritechs' reimagining of the food-system architecture as VF evaluated and governed as critical urban infrastructure, with its pilot projects and specific business model of integrating VF into shared areas of typical urban real estate could eventually help realize the full potential of the vertical farming technology.

This idea reflects the conceptual foundation of an ongoing study by Urban Agritechs and Deloitte to evaluate the impact of vertical farming on (1) food production capacity and food security, (2) urban infrastructure and spatial planning and (3) sustainability.

In the upcoming and subsequent studies, they delve deeper the potential impact and, as a benchmark, quantify spatial requirements and outcomes if Dubai leads the way in adoption of this reimagined paradigm.

They invite policy makers, urban planners, real estate developers and the academia to dig deeper along these dimensions and in areas of policy levers, built environment-integration and economic feasibility from this renewed perspective.

It's inspiring to see previous winners of the Deloitte Technology Fast 50 program leading the way in innovation, using technology to reshape agriculture via vertical farming. This is the true power of the Fast 50 - driving impactful change.

Carolina Arbelaez de la Espriella – Director, Growth Deloitte Private, Deloitte Middle East

Endnotes

[1] Kluczkovski, Alana, Philip Hadley, Christopher Yap, Ulrike Ehgartner, Bob Doherty, and Katherine Denby. 2025. Urban Vertical Farming: Innovation for Food Security and Social Impact Oliveira, Francis José Baumont de. 2022. 'A Decision Support System for Economic Viability and Environmental Impact Assessment of Vertical Farms'. University of Liverpool.

[2] Dal Ri, Sara, Sara Favargiotti, and Rossano Albatici. 2020. 'The Role of Vertical Farming in Re-Thinking and Re-Designing Cities within a Circular Perspective'. Rivista Tema Vol.6 (2020) (N. 1). https://doi.org/10.30682/tema0601i.

[3] Input dependency horizon refers to the length of time food security depends on initial supply, import, or policy inputs.

[4] Graamans, Luuk Jan Adriaan. 2021. 'STACKED: The Building Design, Systems Engineering and Performance Analysis of Plant Factories for Urban Food Production'. A+BE | Architecture and the Built Environment, March 22. https://doi.org/10.7480/ABE.2021.05.

Contributors

Iman Naraghi
Founder
Urban Agritechs

Laura Jepson
Partner
Monitor Deloitte
Deloitte Middle East

Daniel Gribbin
Director
Strategy & Transactions
Deloitte Middle East

Carolina Arbelaez de la Espriella
Director
Growth Deloitte Private
Deloitte Middle East

Deloitte.
Private