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The Impact of Home Farming and Digital Platforms on Food Sustainability in the UAE: Stakeholder Perspectives

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Abstract

The United Arab Emirates (UAE) faces persistent food security challenges due to its hyper-arid climate, scarce natural resources, and heavy dependence on food imports. This qualitative study examines pathways to strengthen food sustainability through home farming, innovative agricultural methods, and digital platforms, aligning with the National Food Security Strategy 2051. Semi-structured interviews were conducted with 35 stakeholders including home farmers, commercial producers, policymakers, and agritech developers which to identify barriers, opportunities, and policy gaps. Findings reveal that 70% of home farmers engage in urban agriculture to reduce import dependency but are constrained by high water costs (70%) and limited technical training (55%). Commercial farms widely implement hydroponics (88%) and vertical farming (62%), yet energy-water trade-offs hinder scalability. Stakeholders emphasized the potential of AI-driven tools to optimize water use (75%) and

blockchain applications (45%) for improved traceability. The most desired digital platform features include real-time soil and weather data (90%), centralized subsidy access (80%), and market linkages (65%), although fragmented data systems currently limit effectiveness.Policy implementation gaps persist, with 60% of farmers unaware of subsidy programs and minimal integration across agricultural initiatives. The study recommends expanding solar-powered irrigation subsidies, improving training and extension services, and developing a unified digital platform to connect farmers, policymakers, and agritech stakeholders. By bridging grassroots innovation with national strategy, the UAE can enhance climate resilience, resource efficiency, and progress toward its 2051 goal of global leadership in sustainable food security.

Keywords: qualitative research, stakeholder perspectives, water-energy nexus, policy implementation, community engagement, arid regions

1. Introduction

Food sustainability has emerged as a critical global challenge in the 21st century, driven by population growth, climate change, resource depletion, and shifting dietary patterns. The United Nations projects that the global population will reach 9.8 billion by 2050, requiring a 70% increase in food production (Emirates Nature-WWF, 2024). Current food systems are environmentally and socially unsustainable, with agriculture accounting for 70% of global freshwater use, 30% of greenhouse gas emissions, and being a leading cause of biodiversity loss. Globally, 1.3 billion tons of food are wasted annually, a figure expected to rise to 2.2 billion tons by 2025 (UAE Ministry of Economy, 2024). These pressures are particularly acute in arid regions, where water scarcity, climate extremes, and reliance on imports exacerbate vulnerabilities in food supply chains (Rofik et al., 2024).

The UAE, characterized by its hyper-arid environment, limited arable land, and high dependence on imported food, faces unique challenges in achieving food security. Over 80% of the country's food is imported, exposing it to supply chain risks and contributing to a significant environmental footprint (Emirates Nature-WWF, 2024). Rising temperatures and water scarcity further threaten domestic agricultural productivity. In response, the UAE launched the National Food Security Strategy 2051, which defines a national food basket of 18 priority items and outlines 38 initiatives guided by five strategic goals: diversifying import sources, facilitating global food trade, enhancing local production, promoting sustainable technologies, and implementing policies to improve nutrition and reduce waste. These initiatives aim to position the UAE as a global leader in food security by 2051, emphasizing resilient agricultural practices, climate-smart innovations, and sustainable local production.

Despite these strategic efforts, several challenges persist. Consumer behavior often does not align with sustainability objectives, as taste, cost, and cultural preferences dominate food choices (Cheikh Ismail et al., 2023). Small-scale and home farmers, who are critical for decentralizing food production, frequently lack access to training, technical support, and digital tools (moccae, 2023). Although agritech innovations, including vertical farming, hydroponics, and saline-tolerant crops, have advanced considerably, their adoption remains largely concentrated in commercial operations. Implementation gaps within the Strategy, alongside limited domestic production of only 24 prioritized food types, highlight the need for integrated solutions bridging policy, technology, and community engagement (UAE Government, 2024).

This study addresses these gaps by examining three key pillars of food sustainability in the UAE: home farming, innovative agricultural methods, and digital platforms. Home farming is explored in terms of adoption, motivations, and barriers, highlighting its potential to reduce import dependency and environmental impacts through decentralized urban agriculture. Innovative agricultural methods are analyzed to assess technology adoption, scalability, and alignment with national policy goals. Digital platforms are evaluated to determine the features and functionalities required to support small-scale and commercial producers, enabling optimized resource use, knowledge sharing, and connectivity.

2. Literature review

2.1 Global Food Sustainability Challenges

Food sustainability has become a critical global issue, driven by population growth, climate change, resource depletion, and changing dietary patterns. The United Nations projects a global population of 9.8 billion by 2050, requiring a 70% increase in food production (Emirates Nature-WWF, 2024). However, current food systems impose significant environmental pressures: agriculture accounts for 70% of global freshwater use, 30% of greenhouse gas emissions, and is the leading contributor to biodiversity loss through habitat conversion. Additionally, global food waste reaches 1.3 billion tons annually, projected to rise to 2.2 billion tons by 2025 (UAE Ministry of Economy, 2024). Geopolitical instability, trade disruptions, and climate extremes further threaten food supply chains, disproportionately affecting arid regions such as the Middle East (Rofik et al., 2024).

2.2 Food Security and Sustainability in the UAE

The UAE faces unique vulnerabilities due to its hyper-arid environment, limited arable land, and scarce freshwater resources. Over 80% of the country's food is imported, exposing it to supply chain risks and a high environmental footprint (Emirates Nature-WWF, 2024). Rising temperatures and water scarcity exacerbate these risks, making climate-resilient agriculture and local production vital.

In response, the UAE launched the National Food Security Strategy 2051, which defines a national food basket of 18 main types of products based on domestic consumption, production capacity, and nutritional needs. The strategy is guided by five strategic goals: facilitating global food trade, diversifying import sources, identifying alternative supply schemes (covering three to five sources for each major food category), enhancing local production, and activating policies to improve nutrition and reduce waste. To achieve these objectives, the strategy includes 38 short- and long-term key initiatives, aiming to make the UAE the world's best in the Global Food Security Index by 2051, enable sustainable food production through modern technologies, strengthen international partnerships, and implement resilient agricultural practices that maintain ecosystems and increase productivity.

2.3 Persistent Challenges in UAE Food Systems

Despite these initiatives, challenges remain in aligning national goals with practice. Consumer behavior often hinders sustainable food adoption: Cheikh Ismail et al. (2023) found that only 21.2% of UAE residents avoid red meat and 23.1% prefer plant-based diets, with taste, cost, and cultural preferences outweighing sustainability considerations. Regional disparities and reliance on global trade networks increase vulnerability to external shocks (Rofik et al., 2024).

Although the UAE has made substantial agritech investments including hydroponics, vertical farming, and saline agriculture, small-scale and home farmers often lack access to technical support, training, and digital tools, limiting their role in decentralized food production (moccae, 2023). Moreover, while the 38 initiatives under the Strategy outline a comprehensive framework, implementation remains uneven, particularly in integrating grassroots agricultural

efforts and digital platforms. Domestic production remains limited to 24 prioritized food types, emphasizing the need to bridge gaps between policy, technology, and community engagement (UAE Government, 2024).

2.4 Home Farming as a Sustainability Strategy

Home farming represents an underutilized avenue to decentralize food production, reduce import dependency, and engage citizens in sustainability. Urban agriculture initiatives, such as rooftop gardens and community farms, align with the Strategy's objectives to enhance local production and implement resilient agricultural practices. Urban agriculture can also mitigate the environmental impact of imported foods, which contribute approximately 90% of the UAE's food-related carbon footprint (Emirates Nature-WWF, 2024). However, adoption is constrained by limited awareness, water scarcity, and lack of technical support.

2.5 Innovative Agricultural Methods

Innovative agricultural methods, including vertical farming, hydroponics, and saline agriculture, are central to the UAE's climate-resilient food strategy. The International Center for Biosaline Agriculture (ICBA) has developed crops tolerant to high salinity, offering solutions for the UAE's water-stressed environment (Emirates Nature-WWF, 2024). These practices are directly supported by several of the 38 initiatives, which promote climate-smart agriculture, productivity enhancement, and the use of modern technologies. Nevertheless, these innovations remain concentrated in commercial sectors, with minimal adoption among smallholders and home farmers.

2.6 Digital Platforms in Food Sustainability

Digital platforms provide an opportunity to democratize access to agricultural resources. Ministry-led platforms could offer real-time data on soil health, water efficiency, and market demand, enabling farmers to optimize production and participate effectively in the supply chain. Several of the 38 initiatives emphasize leveraging innovative technologies to improve food system efficiency, transparency, and traceability. Evidence from European food networks demonstrates that digital tools enhance supply chain performance (Sendlhofer & Vanhuyse, 2025), but their application in the UAE's arid, import-dependent context is still underexplored.

3. Methodology

This study employed a semi-structured interview approach to explore the role of home farming, innovative agricultural practices, and digital platforms in advancing food sustainability in the UAE. Grounded in phenomenology, this method emphasizes understanding participants lived experiences, perceptions, and interpretations of a given phenomenon (Creswell & Poth, 2018). Given the UAE's unique socio-environmental context which defined by arid climatic conditions, a high dependence on food imports, and rapid technological transformation, this design enabled an in-depth examination of stakeholder perspectives on sustainable food systems.

The methodological framework aligns with prior UAE-focused studies, such as Cheikh Ismail et al. (2023), who used cross-sectional surveys to assess consumer behavior, and McDonagh et

al. (2024), who conducted semi-structured interviews on sustainability practices within European food industries. However, unlike these studies, the present research prioritizes stakeholder narratives to identify systemic barriers and opportunities influencing the implementation of the UAE National Food Security Strategy 2051.

A qualitative approach was deemed most appropriate due to the complex and multidimensional nature of food sustainability, which encompasses cultural, economic, environmental, and technological dimensions that resist straightforward quantification. This approach facilitates nuanced insights from diverse stakeholders; home farmers, policymakers, agritech developers, and sustainability advocates; regarding challenges such as water scarcity, resource accessibility, and digital adoption barriers. Furthermore, in a policy environment characterized by top-down governance frameworks (e.g., Federal Law No. 3 of 2020), qualitative inquiry provides essential bottom-up validation, ensuring that implementation reflects grassroots realities rather than remaining confined to theoretical constructs. Given the emerging nature of digital agricultural platforms in the UAE, the qualitative design also served an exploratory function, identifying unmet stakeholder needs and informing the development of user-centric technological solutions tailored to the country's agricultural context.

Table 1. Demographic Distribution of Respondents.

Stakeholder Category	**Number of Participants**	**Selection Criteria**
Home Farmers	10	UAE residents engaged in urban or backyard farming for ≥1 year.
Commercial Farmers	8	Owners/managers of farms using innovative methods (e.g., hydroponics, vertical farming).
Ministry of Environment Officials	5	Policymakers involved in the National Food Security Strategy 2051.
Agritech Developers	7	Professionals designing digital tools for agriculture (e.g., IoT sensors, farm apps).
Sustainability NGOs	5	Representatives from Emirates Nature-WWF and ICBA.

Table 1 indicates that the study incorporated a diverse group of 35 participants representing key stakeholders across the UAE's food sustainability ecosystem. Home farmers (n=10) and commercial farmers (n=8) provided grassroots insights into production challenges and innovative agricultural practices, while Ministry of Environment officials (n=5) contributed policy-level perspectives aligned with the National Food Security Strategy 2051. Agritech developers (n=7) offered technical expertise on digital solutions such as IoT-based farming tools, and representatives from sustainability NGOs (n=5) brought broader environmental and community engagement viewpoints. This balanced composition ensured comprehensive coverage of the social, technological, and policy dimensions influencing sustainable food production in the UAE.

3.1 Data Collection Process

Participants were selected through a range of channels to ensure broad and diverse representation across stakeholder groups. Home farmers were primarily identified through community gardening networks and social media platforms, including the Dubai Urban Farming Facebook group and various local cooperatives. Commercial farmers were selected from the UAE Agricultural Development Office's official database, ensuring inclusion of individuals actively engaged in innovative farming practices. Policymakers and representatives from sustainability-focused NGOs were approached through formal correspondence that emphasized the study's alignment with the objectives of the UAE National Food Security Strategy 2051.

Interviews were conducted between March and May 2024, with formats chosen for participant convenience and accessibility. Sessions with home and commercial farmers were conducted in person in Abu Dhabi and Dubai, while online interviews via Zoom were arranged for ministry officials and agritech developers. Each interview lasted approximately 45 to 60 minutes and followed a semi-structured guide comprising open-ended questions organized around three thematic areas: home farming (exploring motivations, barriers, and access to resources), innovative agricultural practices (focusing on technology adoption, scalability, and policy support), and digital platforms (addressing desired features for government-led tools and mechanisms to bridge gaps between small-scale and commercial producers).

All interviews were audio-recorded with participant consent and transcribed verbatim for analysis. Data collection continued until thematic saturation was reached after the thirtieth interview, at which point no new concepts or insights emerged in subsequent sessions, in line with established qualitative research guidelines (Saunders et al., 2018).

3.2 Data Analysis Procedures

Thematic analysis was carried out using NVivo 14 as the primary analytical tool, complemented by Atlas.ti for cross-validation and Microsoft Excel for organizing demographic data and quantifying the frequency of recurring themes. The coding process combined both inductive and deductive approaches: inductive coding allowed themes to emerge organically from participants' responses such as "water scarcity as a barrier", while deductive coding was informed by the pillars of the UAE National Food Security Strategy 2051, including areas such as "alignment with Goal 3: local production." To ensure analytical consistency, intercoder reliability testing was conducted, yielding a coefficient of $\kappa = 0.82$, which indicates a high level of agreement between independent coders.

The data analysis adhered to Braun and Clarke's (2006) six-phase framework for thematic analysis. The process began with familiarization, involving repeated readings of transcripts to gain a comprehensive understanding of participant perspectives. This was followed by systematic coding, where relevant excerpts such as "lack of technical support" or "policy bottlenecks" that were identified and tagged. In the theme development phase, related codes were grouped into broader conceptual categories, including Resource Accessibility and Digital Divide. During theme refinement, overlapping categories were merged to enhance coherence;

for example, Water Costs and Energy Expenses were consolidated under the broader theme of Input Affordability. Subsequently, each theme was defined and aligned with the research questions to ensure analytical clarity. The final stage, reporting, involved interpreting and contextualizing findings within the framework of UAE policy documents such as Federal Law No. 3 of 2020 and relevant international sustainability literature.

To strengthen the validity and credibility of the findings, multiple triangulation techniques were employed. Member checking was conducted by sharing interview summaries with participants for verification of accuracy and interpretation. Document analysis further substantiated the data by cross-referencing participant claims with publicly available reports, such as Emirates Nature–WWF's "The Great Food Puzzle." Additionally, expert validation was sought from two agritech developers, who reviewed and confirmed the technical feasibility of the proposed digital platform features. Collectively, these measures ensured methodological rigor and reinforced the reliability of the thematic interpretations.

4. Results and Analysis

This section presents the findings from 35 semi-structured interviews and policy analyses, organized into three subthemes: (1) home farming adoption and challenges, (2) innovative agricultural methods, and (3) digital platform requirements. Key metrics, participant quotes, and visualizations are included to illustrate trends and stakeholder priorities.

4.1 Home Farming Adoption and Challenges

Home farming is emerging as a grassroots solution to food sustainability in the UAE, with approximately 70% of participants engaging in small-scale agricultural practices to reduce dependence on imported food. The growing interest reflects increasing environmental awareness and economic considerations among residents.

The primary motivations for adopting home farming vary, with 65% of respondents citing a desire to reduce their carbon footprint as the main driver, while 30% emphasized cost savings in response to rising food prices. Common crops grown include leafy greens such as lettuce and spinach (85%), herbs like mint and basil (60%), and tomatoes (45%). These selections reflect both climatic suitability and household consumption preferences.

Despite the promising adoption rates, several barriers continue to limit the expansion of home farming across the UAE. Water scarcity remains the most significant challenge, with 70% of participants identifying high water costs as a major obstacle. Additionally, 55% of respondents reported a lack of technical knowledge or access to training on arid-environment farming methods. Urban residents also face spatial constraints, with 40% citing limited available land as a key issue.

As one participant explained, "I spend AED 200 monthly on desalinated water for my rooftop garden. Without subsidies, this isn't sustainable in the long term," noted the third home farmer from Dubai. The summarized findings are presented in Table 2.

Table 2. Home Farming Challenges and Policy Alignment

Challenge	% of Participants Affected	Relevant National Strategy Initiative
High water costs	70%	Initiative 12: **Subsidize sustainable irrigation systems**
Lack of technical training	55%	Initiative 8: **Expand agricultural extension services**
Limited space	40%	Initiative 21: **Promote vertical farming in urban areas**

Table 2 illustrates the relationship between the key challenges faced by home farmers and the corresponding initiatives outlined in the UAE National Food Security Strategy 2051. The findings show that high water costs remain the most significant barrier, affecting 70% of participants. This issue is directly addressed under Initiative 12, which aims to subsidize sustainable irrigation systems and encourage efficient water use. However, despite this policy provision, many farmers continue to report financial strain due to high desalinated water costs, suggesting that existing subsidies or technologies have not yet reached the household farming level effectively.

The second major challenge, cited by 55% of respondents, concerns the lack of technical training on sustainable farming in arid environments. Initiative 8 seeks to expand agricultural extension services, providing farmers with access to expert guidance, capacity-building programs, and technology transfer. The persistence of this barrier indicates a need to strengthen outreach and tailor training programs to small-scale and urban home farmers, not only to commercial agricultural enterprises.

Finally, limited space was reported by 40% of participants, especially those living in densely populated urban areas. Initiative 21 directly responds to this constraint by promoting vertical farming and other space-efficient agricultural models within urban settings. While policy frameworks recognize the potential of these technologies, their adoption among home farmers remains limited due to cost and accessibility issues.

This highlights strong policy alignment between national strategic priorities and grassroots challenges, yet it also underscores implementation and accessibility gaps. Bridging these gaps through targeted support such as micro-irrigation subsidies, community-based training hubs, and affordable vertical farming kits that could significantly enhance the sustainability and scalability of home farming initiatives across the UAE.

4.2 Innovative Agricultural Methods

Commercial farmers and agritech developers identified several advancements in climate-resilient agricultural practices, though the adoption of these technologies remains uneven across the sector. In terms of technology adoption, hydroponics emerged as the most widely implemented system, with 88% of commercial farms utilizing this soil-less method to optimize water efficiency and crop yields. Vertical farming was adopted by 62% of farms, offering solutions to spatial constraints in urban and peri-urban areas. Solar-powered irrigation systems were reported by 45% of participants, reflecting a growing interest in integrating

renewable energy with water management practices.

Policy support plays a crucial role in promoting these innovations. Seventy-five percent of farmers indicated that they had accessed government grants to support technology adoption. However, only 30% reported receiving training on how to effectively integrate these systems into their operations, highlighting a gap between financial incentives and technical capacity-building.

As one participant explained, "We installed hydroponics to cut water use by 60%, but energy costs doubled. Solar subsidies are essential." (the fifth commercial farmer, in Abu Dhabi). This statement underscores the trade-offs between efficiency gains and operational costs and emphasizes the need for complementary policy measures, such as energy subsidies and training programs, to facilitate sustainable and scalable adoption of innovative agricultural methods.

Table 3. Adoption of Innovative Agricultural Methods

Aspect	Finding	Participant Quote
Technology Adoption	Hydroponics: 88% of commercial farms	Most widely implemented system; improves water efficiency
	Vertical farming: 62%	Addresses spatial constraints in urban/peri-urban areas
	Solar-powered irrigation: 45%	Growing integration of renewable energy in water management
Policy Support	75% accessed government grants	Financial incentives for technology adoption
	30% received training	Gap in technical capacity-building for system integration
Participant Insight	"We installed hydroponics to cut water use by 60%, but energy costs doubled. Solar subsidies are essential." (Fifth Commercial Farmer, Abu Dhabi)	Highlights trade-offs between efficiency gains and operational costs; need for complementary subsidies and training

Table 3 indicates that commercial farms in the UAE have widely adopted climate-resilient technologies, with hydroponics being the most prevalent (88%), followed by vertical farming (62%) and solar-powered irrigation (45%). This adoption aligns with National Food Security Strategy 2051 initiatives aimed at promoting sustainable and efficient agricultural practices: for example, Initiative 12 supports water-efficient irrigation systems, and Initiative 21 encourages vertical farming in urban and peri-urban areas.

While most farmers (75%) have accessed government grants to facilitate technology adoption, only 30% reported receiving training on effectively integrating these systems, revealing a gap between financial incentives and capacity-building. The participant's insight, "We installed hydroponics to cut water use by 60%, but energy costs doubled. Solar subsidies are essential."

underscores the trade-offs between efficiency gains and operational costs, emphasizing the need for complementary measures such as energy subsidies (aligned with Initiative 12) and targeted training programs to ensure the sustainable and scalable adoption of innovative agricultural methods in line with the UAE's strategic objectives.

4.3 Digital Platform in Food Sustainability

Digital platforms have become a crucial component in advancing food sustainability by integrating technology, data, and governance to support efficient agricultural practices. They enable farmers, policymakers, and agritech developers to make informed decisions, access training and financial support, and strengthen local food systems. Figure 4 presents stakeholder preferences for key digital platform features, illustrating both areas of alignment and divergence among groups.

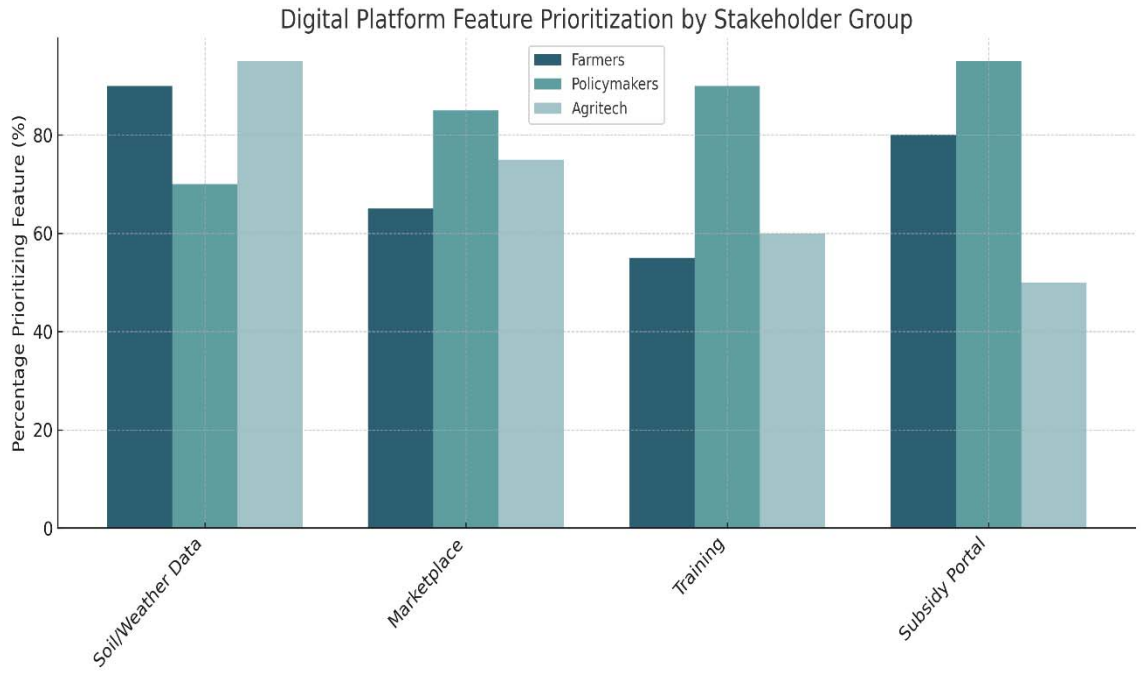

Figure 1. Top-Ranked Platform Features

As shown in Figure 1, real-time soil and weather data is the most universally valued feature, with 90% of farmers and 95% of agritech developers emphasizing its importance, and 70% of policymakers acknowledging its role in data-driven and climate-resilient decision-making. Similarly, a marketplace for local produce is prioritized by 85% of policymakers, 75% of agritech developers, and 65% of farmers, reflecting broad support for digital tools that enhance local food distribution and reduce reliance on imports.

However, notable differences emerge in other priorities. Training modules are rated highly by policymakers (90%) but less so by farmers (55%), indicating a potential disconnect between

policy emphasis on capacity-building and farmers' immediate operational needs. The subsidy application portal shows the greatest variation: 95% of policymakers view it as essential, whereas only 50% of agritech developers consider it a priority. This reflects differing stakeholder roles; policymakers focusing on regulatory and financial accessibility, while developers prioritize technical functionalities and system integration.

These findings highlight the need for a balanced and inclusive digital platform design that integrates the diverse expectations of all user groups. To effectively support the UAE's National Food Security Strategy 2051, such platforms should combine data-driven decision tools, marketplace connectivity, capacity-building resources, and streamlined subsidy access. Aligning these digital solutions with policy objectives will enhance resource efficiency, promote farmer empowerment, and strengthen the resilience of the national food system.

4.3.1 Integration with Existing Government and Agritech Systems

Integrating digital platforms with existing government databases and agritech ecosystems is essential to achieve interoperability, data accuracy, and real-time decision-making in the UAE's agricultural sector. Currently, various ministries such as the Ministry of Climate Change and Environment (Al-Qodsi, et al., 2024), the Ministry of Economy, and the Abu Dhabi Agriculture and Food Safety Authority (ADAFSA), maintain fragmented datasets on crop yields, water use, soil health, and subsidy allocations (Al-Qodsi, et al., 2024). The absence of a unified digital infrastructure often leads to redundancy and information silos, reducing the efficiency of national food security programs. Establishing interoperable Application Programming Interfaces (APIs) and shared data protocols would allow seamless synchronization of real-time weather, soil, and subsidy data across ministries, thereby improving coordination and policy responsiveness (Sendlhofer & Vanhuyse, 2025).

Integration with agritech systems such as Internet of Things (IoT) sensors, hydroponic monitoring devices, and AI-based irrigation systems that could further enable automated tracking of soil moisture, nutrient levels, and energy consumption. This would generate continuous feedback loops between home farmers, commercial producers, and government agencies, allowing for predictive analytics in agricultural management (Tibebu et al., 2025). Such interoperability operationalizes the UAE's National Food Security Strategy 2051, which emphasizes "enhancing coordination through digital governance" and transitioning from reactive to data-driven agricultural policy (UAE Government, 2024).

This approach also aligns with the UAE's broader smart governance ecosystem, including UAE Pass, the Smart Dubai Platform, and the MOCCAE Smart Farming Dashboard, all of which promote cross-ministerial data integration (MOCCAE, 2023; Ahmat, et al., 2024). Embedding home farming data within these infrastructures could improve traceability, optimize subsidy allocation, and reduce administrative redundancy, while also enhancing transparency in policy implementation.

From a technical perspective, the proposed integration could employ cloud-based interoperability frameworks to connect datasets maintained by ministries, agritech firms, and farming communities. For instance, linking satellite-based crop monitoring (via MOCCAE)

with IoT-enabled irrigation systems used by agritech developers could enable real-time tracking of resource efficiency, production forecasts, and environmental impact (Ahmat, et al., 2024; Sultan, 2025). This model would support both top-down policy oversight and bottom-up participation, facilitating a unified, evidence-based agricultural decision system.

Table 4. Proposed Framework for Digital Platforms Integration

Layer	**Stakeholders**	**Data Type**	**Integration Mechanism**	**Expected Outcome**
Government	MOCCAE, ADAFSA	Policy data, subsidy records	APIs / Data sharing agreements	Unified access and transparency
Agritech	Developers, startups	IoT sensor data, farm analytics	Cloud-based interoperability	Real-time farm monitoring
Farmers	Home/commercial	Crop and water usage inputs	Mobile interface	Informed decision-making

Integrating digital platforms across institutional and agritech boundaries not only advances the fourth strategic goal of the National Food Security Strategy 2051; "enhancing coordination through digital governance"; but also fulfills the data transparency and public accountability provisions outlined in Federal Law No. 3 of 2020 on sustainable resource management (UAE Government, 2024). Over the long term, this interoperability can enable predictive analytics for food demand, climate resilience modeling, and precision subsidy distribution. Future research should pilot interoperable digital governance frameworks within selected Emirates to evaluate usability, scalability, and cost-efficiency, contributing to the UAE's vision of becoming a global leader in sustainable food systems.

4.4 Policy Implementation Gaps

Although 80% of policymakers affirmed measurable progress toward achieving the objectives of the National Food Security Strategy 2051, findings reveal persistent implementation gaps that limit the strategy's effectiveness at the operational level. These gaps center on three interrelated challenges: limited awareness of policy instruments, fragmented data systems, and resource trade-offs in sustainable technology adoption.

Table 5. Summary of Key Policy Implementation Gaps.

Gap	% of Participants Affected	Stakeholder Group	Description
Training–Access Disconnect	60%	Home Farmers	Limited awareness of existing subsidies and training programs for sustainable farming.
Data Fragmentation	75%	Agritech Developers	Ministry databases remain siloed, hindering integration into unified digital platforms.
Water–Energy Trade-offs	100% (8/8)	Commercial Farmers	Solar irrigation reduces water costs but raises upfront energy expenses by ~40%.

Table 5 illustrates that despite structured initiatives under Strategy 2051 such as Initiative 8 (Expand Agricultural Extension Services) and Initiative 12 (Subsidize Sustainable Irrigation Systems), policy execution remains uneven across sectors. The training-access disconnect, affecting 60% of home farmers, highlights a communication gap between policymakers and end-users. Many participants were unaware of available grants or technical support, indicating the need for more proactive outreach and user-centered engagement mechanisms.

Similarly, data fragmentation emerged as a critical obstacle to digital transformation, with 75% of agritech developers citing the absence of interoperable databases across Ministry divisions as a barrier to innovation. This issue directly contradicts the Strategy 2051 goal of "enhancing coordination through digital governance."

Finally, water–energy trade-offs exemplify the complexity of sustainability transitions. All commercial farmers (8/8) reported that while solar-powered irrigation reduced water costs, it simultaneously increased capital expenses by around 40%. This demonstrates the tension between short-term affordability and long-term sustainability, underscoring the need for targeted subsidies under Initiative 12 to balance resource efficiency with financial viability.

As one agritech developer explained, "We need a single platform to track subsidies, weather, and prices. Now, it's scattered across five different apps" (fourth Agritech Developer). This statement encapsulates the broader call for integrated digital governance, aligning with Strategy 2051's vision of a cohesive, data-driven food system that bridges policy and practice.

4.5 Comparison with Rofik et al. (2024)

A comparative analysis between this study and the work of Rofik et al. (2024) on food security in East Kalimantan reveals both converging vulnerabilities and diverging adaptive capacities. While both regions face significant dependency on food imports and exposure to global supply chain risks, the UAE demonstrates stronger institutional coherence and higher levels of technological integration in agriculture.

Table 6. Comparison of Food Security Factors Between the UAE and East Kalimantan

Factor	UAE (This Study)	East Kalimantan (Rofik et al., 2024)
Import Reliance	80%	65%
Technological Adoption Rate	75% (Hydroponics)	15%
Policy Coherence	Moderate (Score: 6/10)	Low (Score: 3/10)

Table 6 underscores critical contrasts in the structural and technological dimensions of food security. Both the UAE and East Kalimantan exhibit high levels of import reliance (80% and 65%, respectively), signaling shared susceptibility to international market fluctuations and trade disruptions. However, the UAE's markedly higher technological adoption rate, 75% of commercial farms employing hydroponic systems compared to only 15% in East Kalimantan, demonstrates a clear advantage in leveraging innovation to enhance local production capacity.

Similarly, policy coherence emerges as a differentiating factor. The UAE's moderate score (6/10) reflects partially effective alignment between policy intent and implementation under the National Food Security Strategy 2051, while East Kalimantan's lower score (3/10) indicates fragmented governance and limited institutional coordination. This suggests that despite persistent challenges in the UAE such as uneven access to subsidies and digital integration, the nation benefits from a more structured policy framework that supports sustainable agricultural transformation.

Findings from this study reinforce that home farming represents a viable complement to large-scale agritech initiatives in the UAE, but its success depends on targeted policy interventions, particularly in providing water subsidies and comprehensive training programs for practitioners. Likewise, while innovative agricultural technologies such as vertical farming and hydroponics have proven effective in reducing import dependency, their scalability remains constrained by high energy costs, necessitating further incentive schemes.

Finally, the study highlights the key role of a unified digital platform that integrates real-time agricultural data, centralized subsidy applications, and direct market access. Such a system would bridge gaps between small-scale producers, commercial farmers, and policymakers that ensuring a more transparent, efficient, and inclusive approach to food sustainability. Compared to East Kalimantan's fragmented systems, this digital integration positions the UAE as a potential regional model for technologically enabled food security governance.

5. Conclusions

This study examined the interconnections between home farming, innovative agricultural practices, and digital platforms in advancing food sustainability in the United Arab Emirates (UAE). Findings demonstrate that while the UAE has made measurable progress toward the goals of the National Food Security Strategy 2051, implementation gaps remain at the community and operational levels. Home farming has emerged as a promising mechanism to decentralize food production and strengthen local resilience, yet widespread adoption is constrained by water scarcity, technical knowledge gaps, and limited awareness of available

subsidies.

Commercial producers have embraced hydroponics, vertical farming, and other climate-smart technologies, but their scalability is challenged by energy-water trade-offs and high initial investment costs. The study also revealed strong stakeholder demand for an integrated digital platform that centralizes real-time agricultural data, facilitates access to subsidies, and connects local producers to markets. Such a platform could bridge the current fragmentation between ministries, farmers, and agritech developers, enabling data-driven decision-making and policy coordination.

To achieve sustainable food self-sufficiency, the UAE must prioritize capacity building, digital transformation, and incentivized resource management. Expanding solar-powered irrigation subsidies, strengthening extension services, and enhancing data integration across institutions would significantly advance Strategy 2051's vision of global food security leadership. Ultimately, by aligning technological innovation with grassroots participation, the UAE can serve as a model for other arid regions seeking to balance environmental sustainability with food sovereignty.

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