SMART CONTAINER FARMING: INNOVATIVE URBAN STRAWBERRY FARMING MODEL FROM JAPAN TO THE WORLD

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Abstract - This research investigates the transformative potential of smart container farming, building upon the successful cultivation of Japanese mushrooms at Sakai Farms in Aichi Prefecture, Japan, in strategic collaboration with the Daikei Group Limited. Inspired by this success, the study aims to establish an advanced urban strawberry farming model to understand strawberry farming technologies, foster collaboration, and strategize marketing approaches for both local and global markets. A detailed examination of strawberry farming intricacies informs the technological framework developed for smart containers, which is implemented at Sakai Farms. The study anticipates future trends, outlining avenues for further exploration, stakeholder collaborations, policy considerations, and expansion strategies. Notably, the author expresses a strategic intent to approach the global market, leveraging the foreign student and faculty base at Ritsumeikan Asia Pacific University, where the author is affiliated. This unique approach aims to disseminate the research findings globally, contributing to the broader landscape of agricultural innovation. The integration of various technologies and good agricultural practices in Japan, such as temperature control, air quality control, controlled fertigation, movable rack mounts, and controlled bee pollination, marks a significant stride in the evolution of urban agriculture, aligning with global agricultural trends.

Keywords - Smart Container Farming, Urban Agriculture, Strawberry Farming Technologies, Agricultural Innovation

I. INTRODUCTION

A. Background

The foundation of this research rests on the author's notable success in cultivating Japanese mushrooms (shiitake) within smart containers at Sakai Farms in Aichi Prefecture, Japan. This initial achievement acted as a catalyst, propelling the research towards exploring the feasibility of applying similar innovative techniques to strawberry farming. The proficiency in smart container farming techniques, acquired through collaboration with a dedicated team during the successful mushroom cultivation venture, serves as the cornerstone of this transition.

The decision to broaden the research scope from mushrooms to strawberries is motivated by the recognition of the distinct challenges and opportunities presented by different crops. Among them, strawberries stand out as a highly challenging yet globally accepted fruit, offering lucrative business opportunities. Expanding upon the established infrastructure and expertise at Sakai Farms, the shift to strawberries aligns with the broader objective of enhancing agricultural sustainability through technological innovation. This background not only provides a practical context for the ensuing exploration of strawberry farming but also underscores the author's commitment to pushing the boundaries of conventional agricultural practices using advanced technologies. The success story of Japanese mushroom cultivation serves as the launching pad for a pioneering journey into the realm of smart container farming for strawberries.

B. Promise of Smart Container Farming

Within the evolving landscape of agriculture, this subsection delves into the concept of smart container farming as an innovative and sustainable solution, building a compelling case for its integration into modern farming practices. While acknowledging classic skepticism surrounding the environmental impact of smart containers in the mere context of energy consumption, it asserts that when viewed comprehensively, these containers offer a multitude of green advantages. Smart containers, utilized for both mushroom and strawberry cultivation at Sakai Farms in Aichi Prefecture, Japan, are portrayed as holistic solutions. By embracing organic practices, preserving rare crops, cultivating herbs, utilizing solar energy, and optimizing labor efficiency, smart container farming emerges as an eco-friendly approach. Additionally, the experimentation with low-energy farming practices reflects a commitment to future-proofing agriculture in the face of evolving energy needs. A particularly noteworthy aspect is the potential repurposing of abandoned houses, especially in developed countries like Japan. Smart container farming, when integrated into such structures, transforms them into hubs of agricultural productivity. This innovative repurposing aligns with sustainability goals and addresses issues of urban blight, presenting a forward-thinking solution to underutilized spaces.

Moreover, the subsection positions smart container farming as a strategic response to climatic changes, offering a controlled and adaptable environment that mitigates the impacts of unpredictable weather patterns. Beyond environmental considerations, smart container farming is introduced as a solution for niche markets, exemplified by the cultivation of strawberries in urban areas such as Dubai, Singapore, and Tokyo. This subsection lays a robust foundation, portraying smart container farming not merely as a technological solution but as a holistic, sustainable, and forward-looking model for the future of agriculture.

C. Significance of Urban Strawberry Farming inside Smart Containers

The motivation to delve into urban agriculture arises from the universal appeal of strawberries that transcends cultural boundaries and personal preferences. This section emphasizes the inherent allure of strawberries, viewing them not only as a delicious fruit but also as a compelling incentive as well as a unique opportunity to integrate agriculture into urban landscapes.Delving into the global fascination with strawberries, it paves the way for discussions on employing smart container farming for this beloved fruit. The allure of strawberries prompts the exploration of innovative farming models, especially within the confines of smart containers, aiming to make urban agriculture more accessible, efficient, and environmentally friendly. This subsection underscores the critical role strawberries play as a versatile and universally cherished fruit, making them an ideal candidate for cultivation within urban settings.Urban strawberry farming emerges as a significant endeavor with multifaceted importance, intricately woven into the fabric of local and global agricultural landscapes.

The economic and ecological significance of urban strawberry farming becomes apparent as it presents a scalable model that holds promise for both local and overseas economies. Beyond mere sustenance, strawberries hold cultural and commercial value, offering a dynamic and attractive option for urban agriculture. Moreover, urban strawberry farming contributes to food security, as locally grown produce reduces dependence on distant sources and minimizes the carbon footprint associated with transportation. The accessibility of fresh strawberries in urban areas not only addresses the growing demand for healthier food options but also nurtures a connection between consumers and the origins of their food. This subsection sets the stage for the exploration of smart container farming's role in making urban strawberry cultivation feasible and sustainable. By emphasizing the broader significance of this agricultural pursuit, it lays the groundwork for understanding how innovative technologies can revolutionize urban agriculture, fostering economic growth, environmental sustainability, and community well-being on a global scale.

D. Global Niche Markets for Strawberry

This subsection accentuates the strategic positioning of smart container farming within global niche markets, specifically homing in on the cultivation of strawberries in urban settings like Dubai, Singapore, and Tokyo wherestrawberry farming is impractical in open weather conditions over the year or in off-seasons. Recognizing the unique challenges and demands of these cosmopolitan environments, the research underscores the adaptability and innovation offered by smart container farming. In cities like Dubai, where arable land is scarce, and environmental conditions are demanding, smart container farming emerges as an instrumental solution. The controlled environment within smart containers allows for precise adjustments to temperature, humidity, and other variables, creating an ideal microclimate for strawberry cultivation. Similarly, in densely populated urban areas such as Singapore and Tokyo, where space is at a premium, the vertical and space-efficient nature of smart container farming aligns seamlessly with the need for optimized land use. The cultivation of strawberries in these global niche markets not only addresses the logistical challenges of sourcing fresh produce in urban areas but also taps into the growing consumer demand for locally grown, high-quality fruits. This subsection emphasizes that beyond serving as a solution for food security, smart container farming contributes to the globalization of agriculture, bringing fresh and sustainably cultivated strawberries to cosmopolitan markets. As these global niches continue to evolve, smart container farming positions itself as an innovative and adaptable model capable of meeting the unique demands of diverse urban landscapes.

E. Purpose of this paper

Rooted in the success of cultivating Japanese mushrooms, the purpose of this research emphasizeson devising smart container strawberry farming technologies in Japan. The research elements aligned with this objective are:

1) Clarify the rationale of strawberry farming inside controlled environment situation inside containers in Japan.
2) Identify a supply chain logistics and profitable deployment of smart container strawberry farming in Japan and its expansion to potential overseas markets.
3) Using smart container farming as a subject to integrate synergies of worldwide researchers to combat agricultural issues and foster sustainable farming.

II. CONCLUSION

In conclusion, this research sheds light on the transformative potential of smart container farming, evolving from the prosperous cultivation of Japanese mushrooms to the promising domain of urban strawberry farming. The integration of controlled bee pollination marks a groundbreaking advancement, enhancing sustainability and propelling urban agriculture into a new era.

As we delve into the intricate world of strawberry farming, we acknowledge the challenges posed by this delicate yet globally cherished fruit. From climate sensitivity to susceptibility to diseases, strawberries present unique hurdles. However, the adaptable nature of smart container farming proves instrumental in

overcoming these challenges, providing a controlled and optimized environment for cultivating strawberries. Our study, rooted in the synergies between agricultural innovation and business strategy, positions smart container farming not only as an environmentally friendly and space-efficient solution but also as a catalyst for economic growth and global agricultural collaboration. The significance of urban strawberry farming within smart containers extends beyond the cultivation of a beloved fruit; it intertwines economic, ecological, and cultural aspects, presenting a scalable model for both local and overseas markets.

Looking ahead, the research recognizes the global expansion potential of smart container strawberry farming. The strategic positioning within international markets, particularly in cities like Dubai, Singapore, and Tokyo, demonstrates the adaptability of this innovative farming model to address unique challenges in cosmopolitan environments. The cultivation of strawberries in these global niche markets not only addresses logistical challenges but also taps into the growing demand for locally grown, high-quality fruits, contributing to the globalization of agriculture.

As we conclude, this study invites further exploration of strawberry farming within smart containers, emphasizing its dynamic and evolving nature. Challenges notwithstanding, the resilient and sustainable attributes of smart container farming position it as a transformative force in shaping the future of urban agriculture globally. Our commitment to disseminating findings internationally through collaborations at Ritsumeikan Asia Pacific University underscores a strategic intent to contribute to the broader landscape of agricultural innovation, fostering sustainable farming practices, and addressing global challenges. With success stories, innovative technologies, and a strategic global perspective, smart container farming stands poised to revolutionize the way we approach urban agriculture on a worldwide scale.

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Figure 1: Trial 1 -, three samples growing under different lighting setup.



Figure 2: Trail 2 – LED setup of a photonics chamber

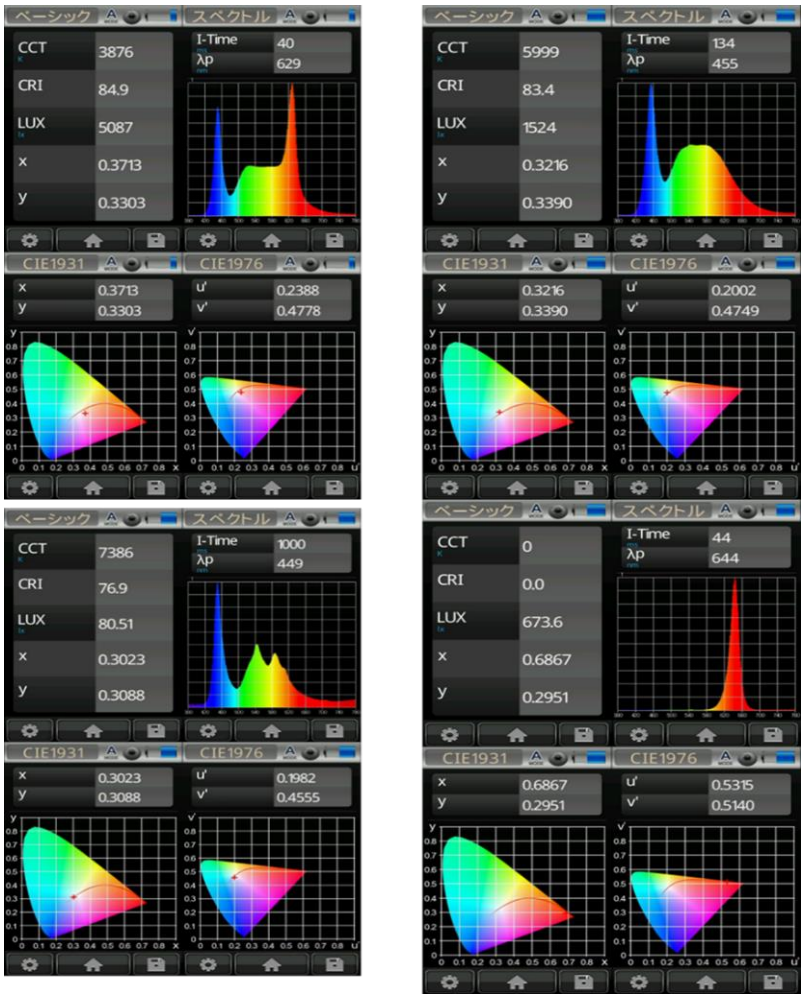


Figure 3: Trail 1 – LED spectrums of four samples

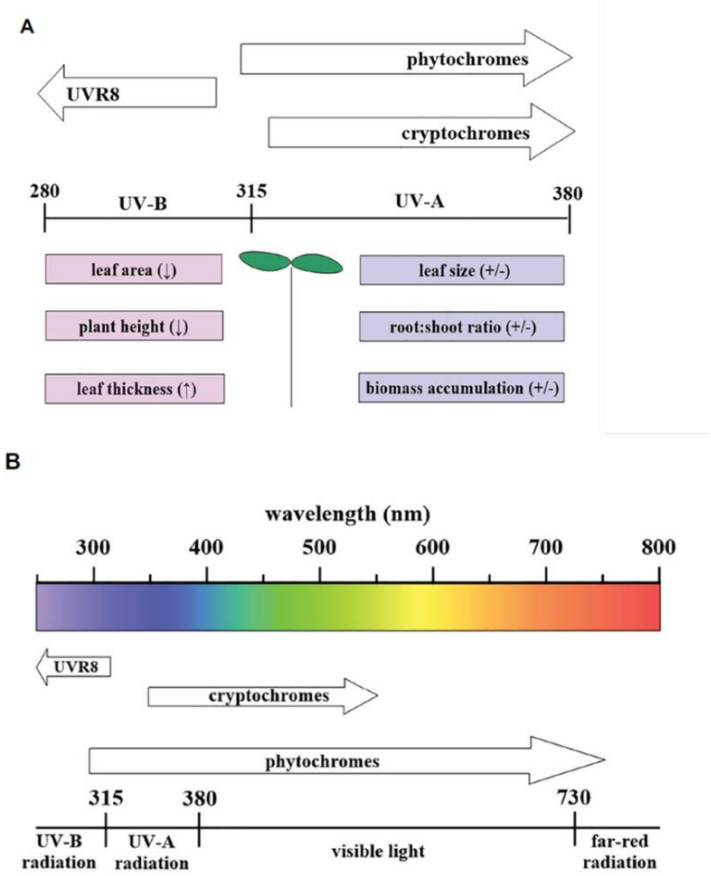


Figure 4: Trail 1 – Light Spectrum and Bee pollination

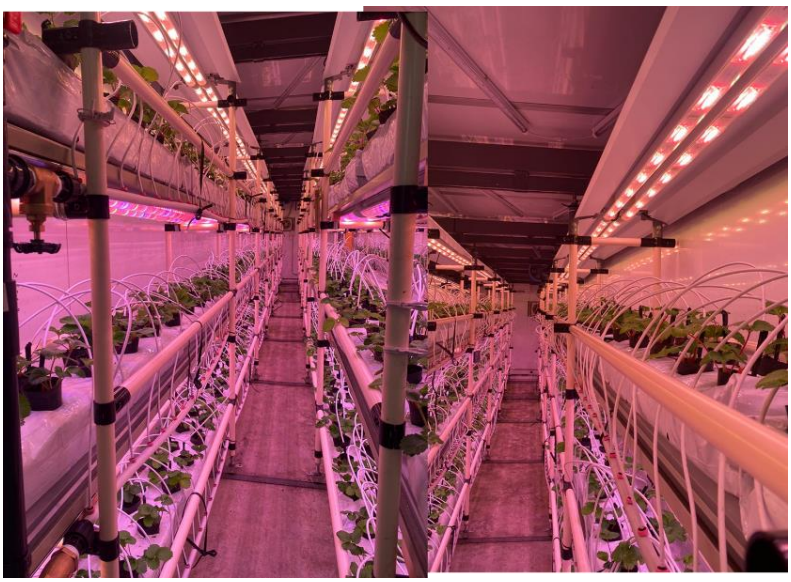


Figure 5: Trail 2 – Full scale experiment 1000 Plants

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