OptimIA

Research Highlights

Potential Profitability and Economic Success of Indoor Agriculture in the United States

Valle de Souza, S.*, Peterson, H. C., Seong, J.

Plant Factory Basics, Applications and Advances. Ed. Kozai, T. et al (forthcoming)
Chapter 14: Emerging Economics and Profitability of PFALs

***Simone Valle de Souza, Michigan State University; E-mail: valledes@msu.edu**

This forthcoming book examines all dimensions of what the Japanese industry calls Plant Factories with Artificial Lighting, or PFALs for short. The chapter uses the PFAL model to examine indoor agriculture (IA) profitability including its application to the US IA industry. This fact sheet draws on key findings from the chapter.

A summary of several market research reports cited in the chapter evidences great improvements in IA profitability in the U.S., showing the number of vertical farms operators reporting profitability to increase from 27% in 2017 to 37% in 2019—still not fully desirable for long-tern economic health. These reports also depict a growing segmentation in the industry between large IA growers focusing on economies of scale; medium growers focusing on specific niches; and a large number of small growers serving local communities, restaurants, and supermarkets.

Proprietary data restrictions, however, remains a hurdle to be overcome in the complex task of developing detailed analysis of profitability of IA. Publicly available profitability analyses are limited to estimates of most profitable crops, average yield and revenue per sq. ft., and the proportion of costs associated with key production factors. In a nutshell, these benchmarking data inform that the most profitable indoor farms are those focusing on leafy greens, microgreens, and herbs; suggesting industry average values for annual sales of leafy greens averaging $125/sq. ft while microgreen and herb revenues can vary between $100/sq. ft. and $875/sq. ft. Operational costs in IA are reported to be on average almost $40/sq. ft, making for the biggest challenge of the industry with half attributed to labor, followed by energy costs. The main constraint for new firms to enter this industry remains the large initial capital and working capital requirements, followed by high operating costs and lack of reliable and skilled labor.

Profitability is discussed using a base case of a Japanese PFAL (Kozai, 2018). Well-crafted "what if" scenarios simulate changes in profitability resulting in estimated Return on Investment (ROI) based on Earnings before Interest and Taxes (EBIT). The base case allows tracking key drivers of profitability and tracing their impact on an often-used key profit measure such as ROI. The scenario findings include:

1. Changes to Required Capital Investment. Based on 2016 capital costs, the model PFAL only had an ROI of 1.8%. By 2020, equipment costs fell approximately 45% (from $2.2 million to $1.2 million) increasing the proforma ROI from 1.8% to 14.3%. The dramatic decline resulted from supplier competition to equip a standard PFAL design—a benefit of the industry working together to create common standards.

2. Changes to scale. Half scale essentially results in breakeven profitability, while doubled scale pushes ROI for the base case (after the capital cost decline) from 14.3% to nearly 22%. As expected, scale is critical to profitability.

3. Changes in Operations. A decrease in growth cycle (number of days in cycle) by 10% raised ROI from 14.3% to just under 20%. A 20% increase in plant density per meter raised ROI from 14.3% to nearly 26%. An 10% increase in plant size resulting from efficiency innovation in lighting, nutrients, or genetics raised ROI from 14.3% to nearly 26%. A 20% increase the efficient use of electricity resulting in a 20% decrease in KWHs consumed, raised ROI from 14.3% in the base case to nearly 17%. As one considers making changes in PFAL operations, profitability is more impacted by biomass output enhancements than by individual cost minimization.

4. Changes in Market Context. Labor cost, alternative crop selection, and output prices were each modelled in a scenario. Based on the premise that labor costs can vary significantly between countries, US labor costs were substituted for Japanese labor costs. This change increased labor costs by 76% and ROI dropped significantly from 14.3% to 1.8%. When the same physical structure is used for an alternative crop (having 28 day rather than 38 day cycle and no transplanting within cycle), the resulting scenario had the facility growing 70% more plants, revenue increased by approximately 40% while EBIT became 2.7 times larger and ROI jumped to 38.1%. Finding such an alternate crop is critical to the credibility of this scenario. The scenario implies that such a search could be highly valuable. Finally, achieving profitability through price enhancement was examined. Examining the hypothesis that profitability hinges critically on a premium price for a specialty product, this scenario showed that an additional 5% price increase takes ROI from 14.31% to 20% without the need for operating or scale changes.

Summary of Findings

- All examined changes (capital costs, scale, operational changes that enhance biomass and lower costs, and the market context for labor, alternative crops, and output price) resulted in substantial improvements in PFAL profitability.
- The changes with the most potential to increase profitability are those that focus on enhancing market price for the quality of product delivered, decreasing capital costs, and improving elements of biomass (plant size, density, and type of crop).

Take-Home Message

- IA profitability hinges on the revenue side as well as the cost side. IA should reap the benefits of its control over product attributes commanding a premium price in the marketplace. Innovating pieces of the system must not only enhance productivity and drive down costs but maintain or enhance product attributes that buyers will pay for. Every IA innovation has a revenue impact as well as a cost impact. Both must be evaluated in the decision to enhance profitability.

MICHIGAN STATE UNIVERSITY

USDA NIFA

www.scri-optimia.org