A DATA ANALYTICS STRATEGY FOR ATLAS URBAN FARMS

Executive Summary

This report delivers a daa-driven strategy to help **Atlas Urban Farms**[1], a Boston-based innovator in modular hydroponic systems, evolve from a hardware-focused business into a smart analytics platform. Analysis of five core datasets revealed critical data quality issues—such as inconsistent formats and poor integration—but still enabled actionable insights into how growing conditions influence flavor, yield, and plant health. To capitalize on these findings, we propose five AI-powered tools: The **Atlas Flavor Optimizer™**, **Growth Prediction Engine™**, **Plant Health Monitor™**, **Nutrient Optimizer™**, and **GrowBot™**, each designed to deliver precision, reduce waste, and personalize the growing experience. Implementing these solutions through an 18-month phased roadmap would position Atlas to shift toward subscription-based services and lead the next generation of data-driven urban agriculture.

Section 1: Data Quality Assessment

We audited five key datasets to identify quality issues affecting usability across accuracy, completeness, consistency, timeliness, and validity:

File Name	Data Quality Issues	Severity	Recommendations
Rate Test Outputs Rate Test Growth Rates.csv	• Column naming inconsistencies (numbered columns) • Excessive columns (54) with unclear labels • Unnamed columns (Unnamed: 8, etc.) • Lack of descriptive headers	H	• Rename columns with meaningful descriptors • Consolidate or remove unnecessary columns • Document column purposes • Add data dictionary
Rate Test Outputs Parameters.csv	• Limited dataset (only 1 row) • Natural Light column as string not numeric • Missing data documentation for plant types	M	• Collect more parameter data points • Convert Natural Light to numeric format • Add plant type dictionary
Rate Test Outputs 9_23 Rate Test Harvest.csv	• Qualitative data lacking standardization • Inconsistent formatting (Level vs Side)	M	• Create standardized scales for measures • Document measurement methodologies • Ensure consistency between files
Rate Test Inputs Sun Data.csv	• Time data stored as strings not time format • Hours of Daylight in string format • Limited records (34 rows) for time-series	L	• Convert time data to proper datetime format • Calculate Hours of Daylight as numeric • Consider more frequent measurements
Rate Test Inputs.csv	• Inconsistent float formatting • Non-descriptive column header "ID" • Missing relationships between datasets • Unclear "Dataset" column purpose	H	• Standardize measurement units • Improve column naming convention • Document dataset relationships • Create foreign key connections

Table 1: Data Quality Assessment

[1] Atlas Urban Farms

Implications: While meaningful analysis was still possible, inconsistent formats, missing values, and unstructured fields made the process slower and less reliable. Improving data structure would enhance both the speed and accuracy of insights.

Section 2: Data Analysis & Visualization

a. Environmental factor Analysis.

The experiment was conducted over a 33-day period from August 21 to September 23, 2023, in a controlled indoor environment with consistent monitoring of water chemistry, ambient temperature, and humidity to establish baseline environmental conditions for optimal plant growth.

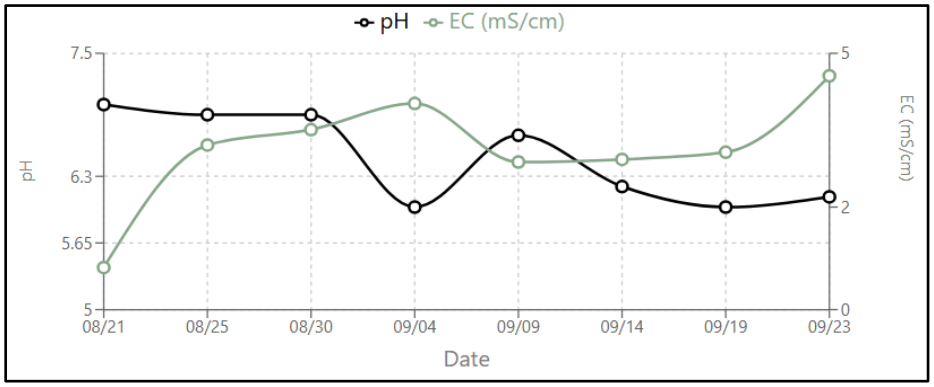

Figure 1: Water Chemistry: PH and EC

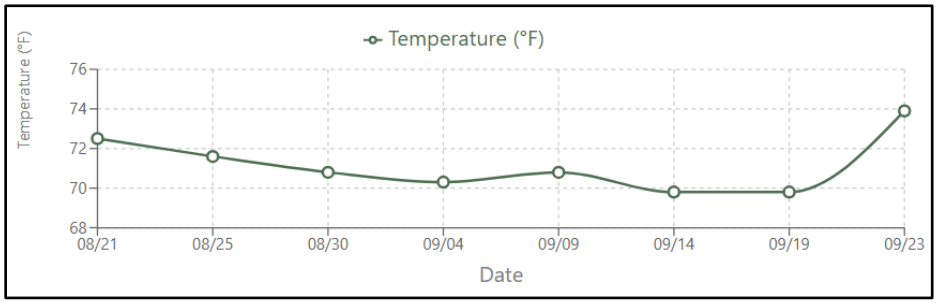

Figure 2: Temperature Trends

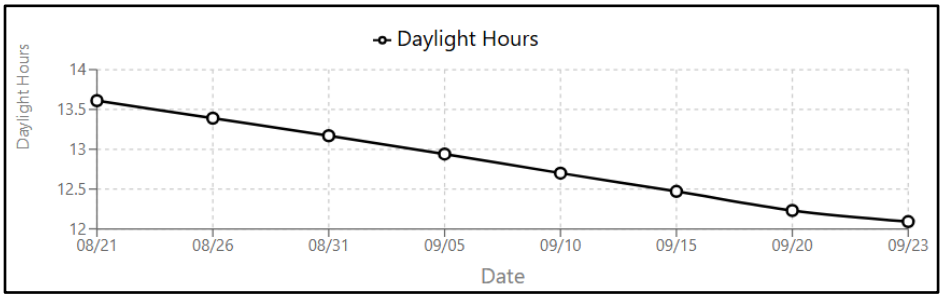

Figure 3: Daylight Hours

Insights: Over the course of the 34-day growing period, **pH levels gradually decreased** from **7.0 to around 6.1**, indicating a rise in acidity that may have impacted nutrient availability. At the same time, **electrical conductivity (EC)** increased substantially from **0.82 to 4.56 mS/cm**, reflecting ongoing **nutrient additions** and accumulation in the system.

Temperature remained relatively stable, with only slight variations between **69.8°F and 73.9°F**, providing consistent thermal conditions. Additionally, **daylight hours decreased by approximately 1.5 hours (11.2%)**, which could have influenced overall plant metabolism and growth dynamics.

b. Comparing plant growth metrics between window-side and room-side positions.

This chart was created to visualize the consistent performance differences between window-side and room-side plants across all key metrics. Using data from both the **"Rate Test Outputs – 9/23 Rate Test Harvest.csv"** and the **"Rate Test Outputs – Rate Test Growth Rates.csv"**, the goal was to highlight how exposure to natural light impacts plant development.

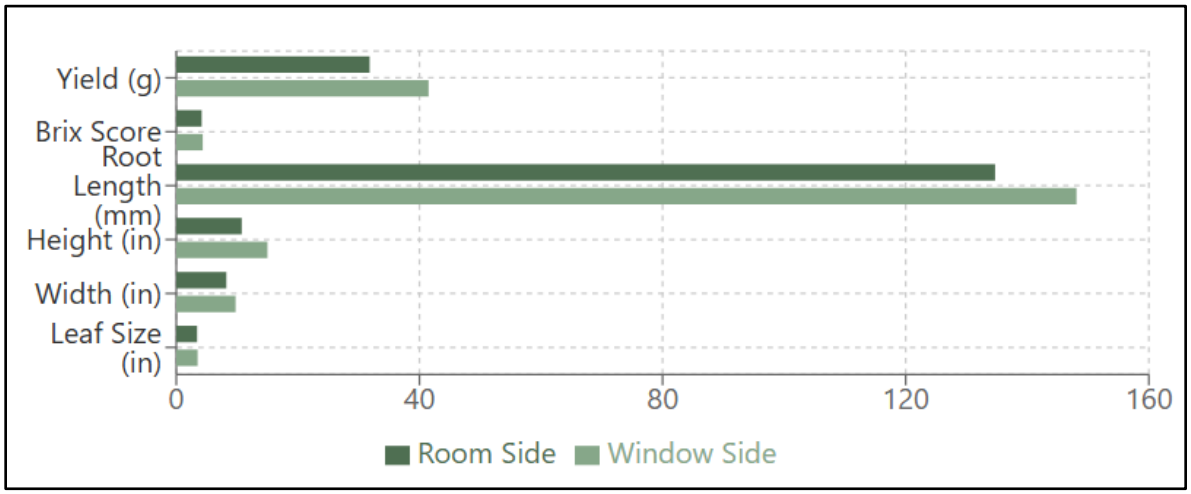

Figure 4: Window vs Room Side Comparison

Insights: The side-by-side bar chart format clearly illustrates these differences, revealing that plants located on the **window side** consistently outperformed those on the room side. The most significant improvement was observed in **yield**, which was **30.5% higher** for window-side plants. Additionally, **plant height** increased by **39.3%**, indicating enhanced vertical growth near natural light sources.

Root development also showed a **9.9% improvement**, suggesting stronger below-ground growth in naturally lit conditions. In terms of quality, **Brix values**—a proxy for sugar content and flavor—were **4.2% higher** for window-side plants. Notably, **leaf size** showed only minimal variation between the two sides, suggesting this trait may be less sensitive to light exposure or orientation.

c. Examining how vertical position affects plant growth and yield.

Separate charts for yield/quality, root development, and plant dimensions were created to clearly show how **vertical position** affects plant performance. By analyzing data from **"Rate Test Outputs – Rate Test Growth Rates.csv"** alongside **harvest data**, **optimal growing heights** were identified without the visual clutter of overlapping data.

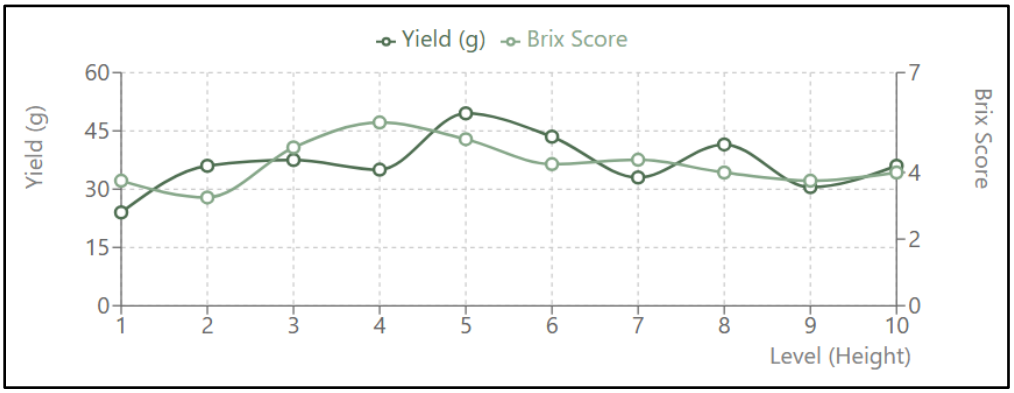

Figure 5: Yield and quality by Level

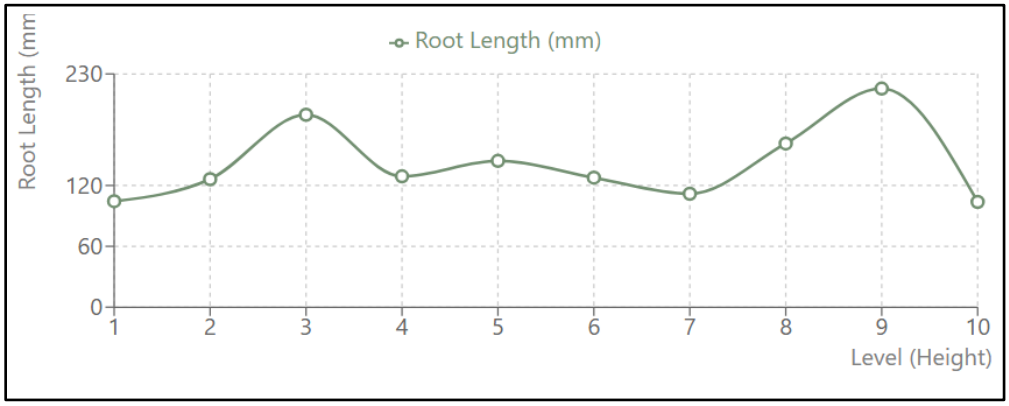

Figure 6: Root Development by Level

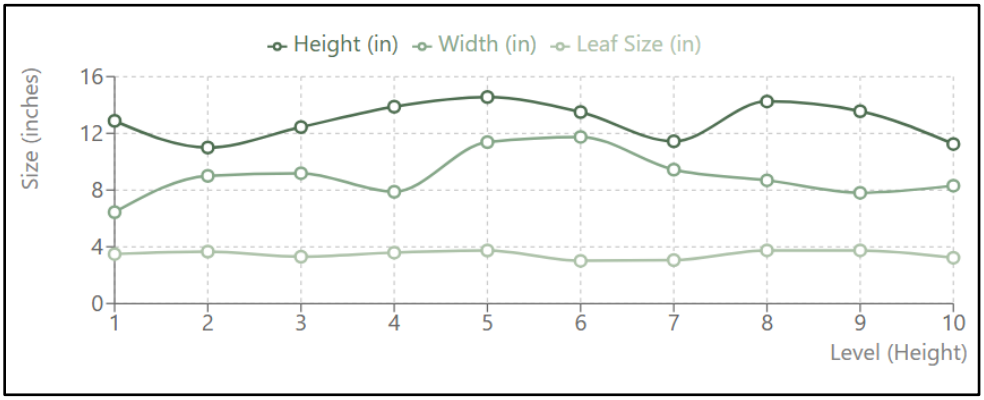

Figure 7: Plant dimensions by Level

Insights: **Analysis of vertical positioning** within the growing system revealed clear performance patterns. **Middle levels (5 and 6)** delivered the **highest yields** at **49.5g** and **43.5g**, while **Level 4** recorded the **highest Brix score** at **5.5**, indicating superior flavor and sugar content. **Level 9** showed the strongest **root development** at **215.5mm**. **Brix**, a measure of sugar concentration, correlates with flavor quality. A weak trend suggests **yield increases by 0.47g per level**, offering a slight height advantage. **Level 5** produced the **tallest plants** at **14.56 inches**, and **plant width** peaked at **Levels 5 and 6** (11.38–11.75 inches).

d. Flavor Analysis by Side.

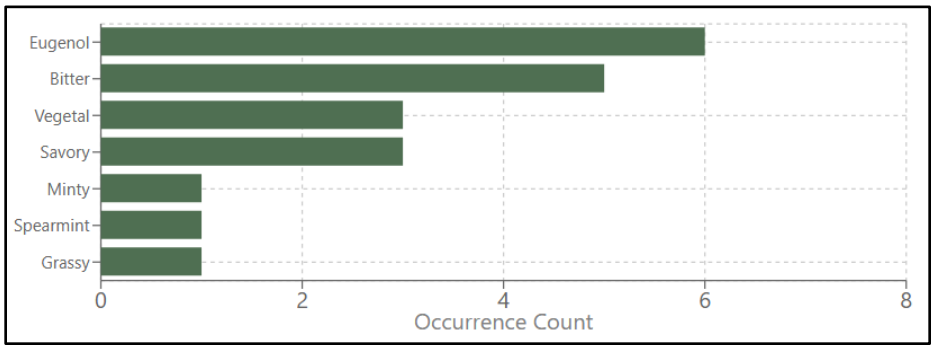

Figure 8: Room Side Flavor Profile

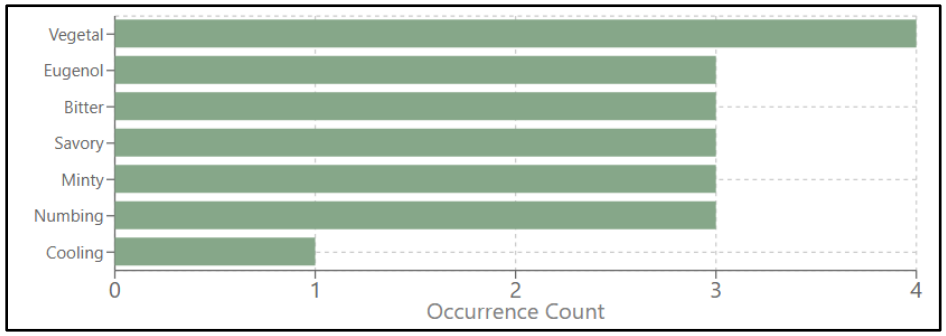

Figure 9: Window Side Flavor Occurrence

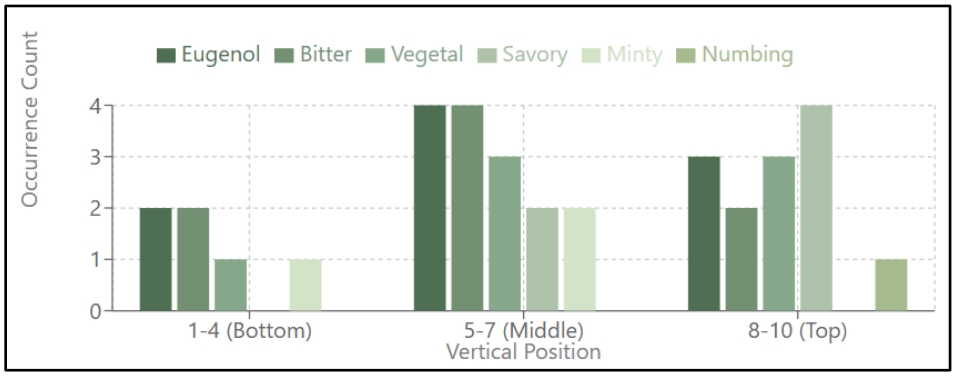

Figure 10: Flavor Profile Distribution by Vertical Position

Insights: Flavor analysis revealed that **room-side plants** tended to exhibit **stronger eugenol and bitter profiles** with less complexity, while **window-side plants** developed **more diverse flavor profiles**, showing higher occurrences of **vegetal, minty, and numbing characteristics**. Plants grown at **middle levels (5–7)** produced the most **complex and varied flavor combinations**, highlighting the influence of vertical positioning. On average, **window-side plants exhibited 3.1 distinct flavor notes**, compared to **2.3 notes** for those grown on the room side, reinforcing the role of natural light in enhancing flavor diversity.

Section 3: Strategic Recommendations for Value Creation

Drawing from our data analysis, we now present strategic recommendations to transform Atlas Urban Farms from a hardware-focused growing system provider into a data-driven plant optimization platform. **(See Table 2: Strategic Data-Driven Value Propositions).**

Conclusion

Atlas Urban Farms' evolution from hardware provider to data-driven agriculture technology company addresses emerging market needs while creating sustainable competitive advantages. Our analysis revealed significant opportunities to extract value that can transform urban farming approaches, despite current data quality challenges.

The five recommended AI-powered innovations form a comprehensive ecosystem addressing key challenges in urban farming: quality consistency, resource optimization, crop loss prevention, and knowledge barriers. This shifts Atlas's value proposition from selling equipment to delivering optimized growing outcomes.

Generative AI bridges the gap between complex sensor data and actionable insights, making sophisticated growing knowledge accessible to all skill levels. As these systems learn from expanding datasets, they create a virtuous cycle strengthening Atlas's market position over time.

The phased implementation approach allows Atlas to demonstrate value quickly while building toward more advanced capabilities. By addressing data quality issues early, Atlas can establish proof of concept while developing more sophisticated features.

The urban farming industry stands at an inflection point where data-driven approaches can unlock unprecedented efficiency. Atlas Urban Farms has the opportunity to lead this evolution, establishing the standard for intelligent growing solutions in next-generation agriculture while creating sustainable recurring revenue streams.

Recommendation	Key Finding	Value Proposition	Implementation Components	Generative AI Application	Business Impact
1. Atlas Flavor Optimizer™	Significant flavor variations correlate with plant positioning (level and side) within the growing system, with Brix measurements consistently varying	Interactive tool allowing growers to precisely target specific flavor outcomes through controlled positioning and parameter adjustments.	Flavor Profiling Dashboard + Predictive Flavor Algorithm + Culinary Specification System + Parameter Optimization Engine	GenAI creates flavor profile descriptions from numerical Brix data, Generates natural language recommendations for achieving specific flavor targets, Creates complex correlation models between environmental conditions and flavor outcomes, Develops personalized flavor recipes based on customer preferences	Atlas enables standardized flavor production for the food industry. This flavor-first approach differentiates the brand from competitors and opens new revenue streams through premium pricing opportunities.
2. Atlas Growth Prediction Engine™	Plant development follows predictable patterns that can be mathematically modeled when controlling for environmental variables.	Real-time growth prediction system that forecasts harvest dates, yields, and resource requirements with high accuracy.	Interactive growth timeline visualization + Customizable growth modeling by plant variety + Harvest scheduling optimization tool + Resource allocation planning system	GenAI translates complex growth models into intuitive visualizations, Creates natural language growth narratives from data points, Generates personalized growth trajectory predictions, Enables "what-if" scenario planning for different environmental conditions	Improves harvest timing accuracy by 30–40% + Reduces resource waste through precise planning + Enables just-in-time production models + Supports subscription-based revenue model
3. Atlas Plant Health Monitor™	Subtle correlations exist between environmental parameters and early indicators of plant stress, particularly in pH fluctuations and temperature variations.	AI-powered monitoring system that detects developing problems before visual symptoms appear and recommends immediate interventions.	Real-time anomaly detection algorithm + Customizable alert thresholds by plant variety + Visual health status dashboard + Intervention recommendation engine	GenAI produces explanatory content about detected anomalies, Creates custom intervention protocols based on specific conditions, Generates visual representations of plant health status, Develops predictive narratives of potential issue development	Reduces crop losses by up to 50% + Decreases maintenance costs through early intervention + Improves overall yield quality and consistency + Creates opportunity for premium support service tiers
4. Atlas Nutrient Optimizer™	Optimal nutrient profiles change significantly throughout the plant growth cycle, with specific EC ranges correlating to improved growth at different stages.	Adaptive nutrient delivery system that provides precise formulations based on growth stage and desired outcomes.	Growth stage recognition system + Dynamic nutrient recipe generator + Automated dosing recommendation engine + Outcome-based optimization algorithm	GenAI translates complex nutrient interactions into simple instructions, Creates custom nutrient recipes for specific growth outcomes, Generates natural language explanations of nutrient adjustments, Develops personalized nutrient plans based on historical performance	Improves resource efficiency by 20–30% + Enhances crop quality metrics + Reduces environmental impact of nutrient runoff + Enables premium "nutrient as a service" offering
5. Atlas GrowBot™	Data interpretation is a significant barrier for many urban farmers, with most lacking expertise to translate readings into growing decisions.	Conversational AI assistant that provides real-time guidance, answers questions, interprets sensor data, and delivers personalized recommendations in natural	Natural Language Interface + Personalized Knowledge Base + Data Interpretation Engine + Visual Recognition Integration + Predictive Problem-Solving	GenAI powers natural language understanding of growing-specific questions, Creates contextual responses based on user's specific setup, Generates personalized growing advice based on historical data, Enables multimodal interactions with text and image input, Produces explanatory content on complex growing topics	Democratizes growing expertise for all skill levels + Creates continuous engagement touchpoint with users + Significantly lowers support costs through automation + Enables tiered service model with premium AI assistance

Table 2: Strategic Data-Driven Value Propositions

*This report was written with the assistance of AI tools, including **OpenAI's ChatGPT (March 2025 version)** and **Anthropic's Claude (accessed March 24, 2025)**, which supported data analysis, visualization guidance, and written content refinement.*