

Bringing urban farming to new heights through breakthrough technologies and innovative business models

Vertical farming in Japan

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Kobe University



- What is a plant factory?
- Present status and problems
- The future of plant factory
- Study policy in Kobe University



Type of plant factory

The supplement light type

- includes greenhouse and admits sunlight
- The sunlight itself is free but the cost for cooling in summer is very high



The artificial light type



- insulates the interior from outside elements
- allows no sunlight to penetrate
- are high cost in initial construction
- is to keep the interior environment optimal and constant
- is more commonly used in Japan

Contrast of agriculture in open fields and in plant factory

Agriculture in open fields

- affected by climate
- uses pesticides or insecticides
- is to realize large-scale production



Agriculture in plant factory



- Climate is not consideration
- No pesticides and insecticides
- Yields per square meter is larger than that in open field
- Initial construction cost is very high

Environmental factors to be controlled

Above ground part:

- temperature
- relative humidity
- light
- concentration of carbon dioxide
- wind velocity



Around the root system:

- pH level
- electric conductivity
- temperature
- concentration of dissolved oxygen in solution
- disinfectant





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Contents - Present status and problems



- Current level of prevalence
- Fundamental research themes



The current level of prevalence of plant factory use

In 1990, the first plants that were produced in a plant factory were sold

In 1993, the Ministry of Agriculture began subsidizing plant factory construction

In 2000, the Ministry discontinued the subsidization

In 2004, there were 20-odd plant factories in operation nationwide

Although over this 15-year period many companies entered the plant factory business, many of them have since from the beginning until now pulled out.

In 2008, plant factories were included as part of government's economic strategy

In 2009, plant factories were included as a stimulus package to the economic crisis

This is being accomplished in two ways.

- Firstly the number of plant factory sites has been increased from the initial number of 50 sites to 150.
- A target of 30 % reduction in production costs was set.
- Ministry of Agriculture and Economy to a total of 8 billion yen

Current prevalence of plant factories in Japan

	The artificial light type	The supplement light type
February, 2023	194	43
February, 2022	190	38
February, 2021	187	33
February, 2020	187	35
February, 2019	202	30
February, 2018	183	32
February, 2017	197	31
February, 2016	191	36
March, 2015	185	33
March, 2014	165	33
March, 2013	125	28
March, 2012	106	21
March, 2011	64	16

- At present 230-odd sites have been constructed.
- The number growth tends to slow down.

(<https://jgha.com/wp-content/uploads/2023/03/TM06-04-bessatsu1.pdf>)

Current prevalence; Floor area of factory

- The supplement light type
 - 1,000~5,000 m² : 27 %
 - 5,000~10,000 m²: 20 %
 - Mean area: 21,000 m²
- The artificial light type
 - 1,000~5,000 m² : 38 %
 - less than 500 m²: 34 %
 - Mean area: 1,400 m²

Current prevalence; Cultivar of vegetables

- The supplement light type
 - Tomatoes: 27 %
 - **Strawberries** : 13 %
 - Lettuces : 27 %
 - Flowers: 20 %
- The artificial light type
 - Lettuces : 91 %

The characteristics of plant factory vegetables

12

– Sales channel in 2004

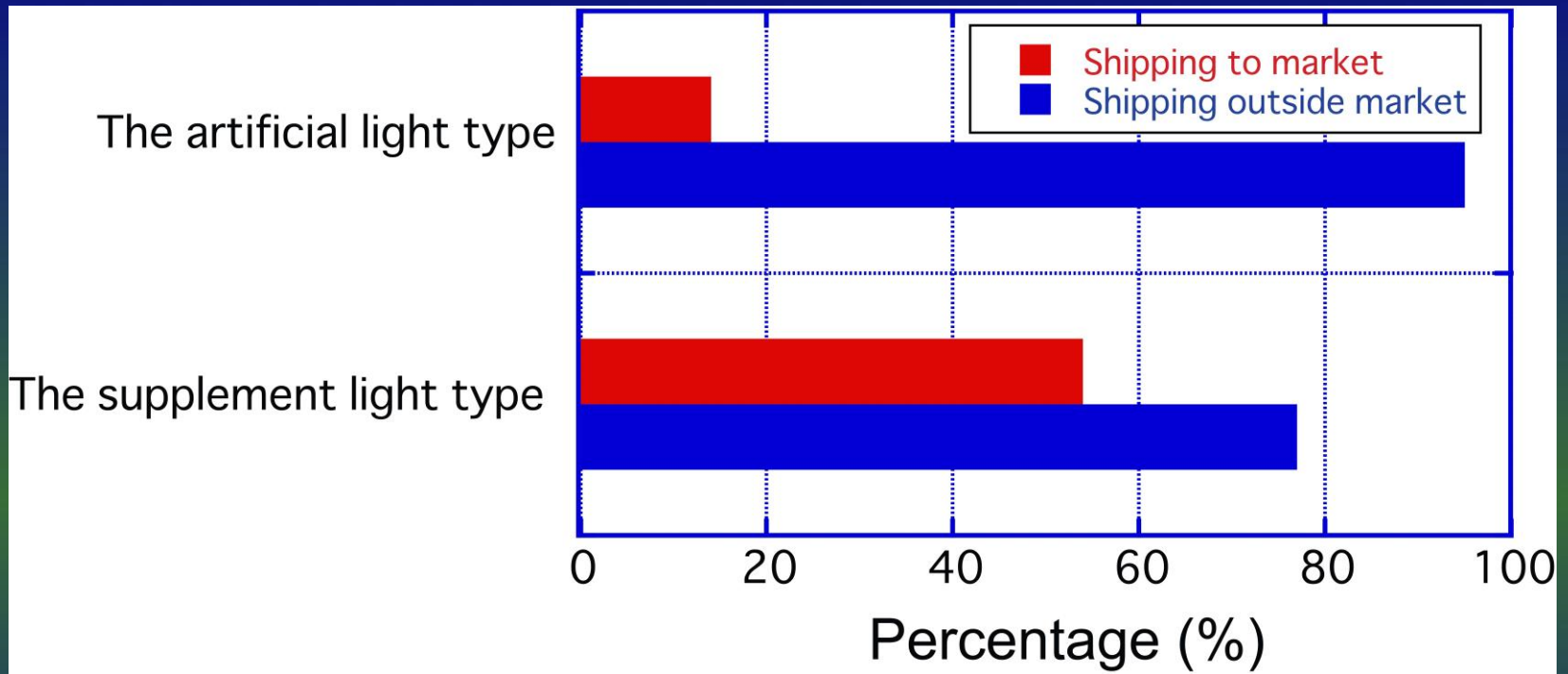
- 50 % of shipped yield were sold to restaurant chains and food and beverage industry brokers.
- The remainder was sold through direct contracts with mass retailers, such as supermarket and department stores.

Requirements from the food and beverage industry

- Production volumes and prices should remain constant throughout the year
- Visual appearance and safety should be guaranteed
- Production under strict sanitary control
- Transparency and traceability in production process
- Pesticide and insecticide free
- No washing necessary

Plant factory vegetable is ideal for take away restaurants.

Sales channel – Current trend



(<https://jgha.com/wp-content/uploads/2023/03/TM06-04-bessatsu1.pdf>)

- The 95 % of vegetables cultivated in the artificial light type were sold outside market such as retails and food industries.

Contents - Present status and problems

- Current level of prevalence



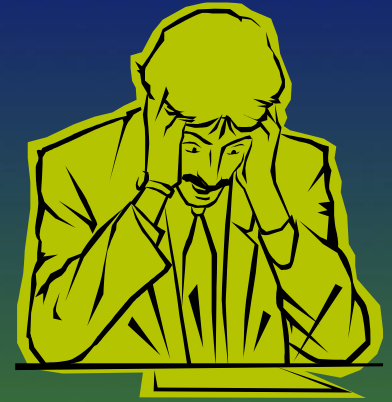
- Fundamental research themes



Merit and demerit of plant factory vegetables

Demerit: High price

- high cost in initial construction and operating expenses
- higher than the cost in open field or horticultural facilities
- needs to seek a new sales channel



Merit:

- Pesticide and insecticide free
- Cleanliness
- Remaining constant production volume and price

Strategies to improve the plant factory business

- Reduction of production costs
- Production of high-value added plants

Average breakdown of production cost

- 20 %: Energy costs
- 35 %: Labor costs
- 40 %: Depreciation cost

Energy and labor costs account for large percentage of production cost.

Revenue and expenditure of plant factories

- Percentage of factories that maintain its balance
 - The supplement light type: 60 %
 - The artificial light type: 43 %
 - Plant factory is not surplus business.
- Consumer does not recognize the added value of products compared with that in the field.
 - Lowering the price
 - High energy and labor costs
 - Fall into the red

Is the relationship between complex environment and plant growth clear?



light

humidity



temperature



CO₂

solution
pH



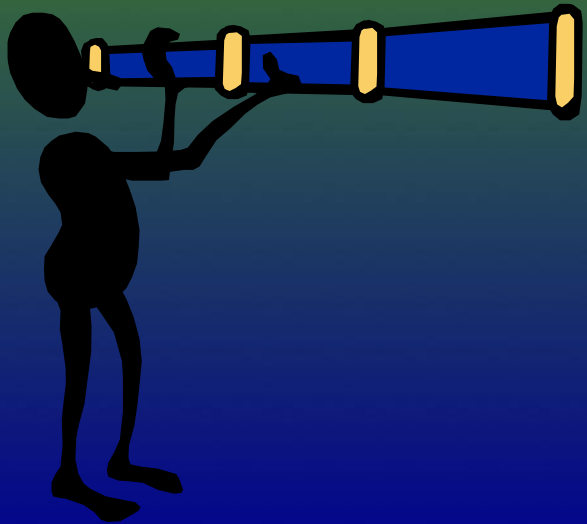
solution
temperature

solution
EC



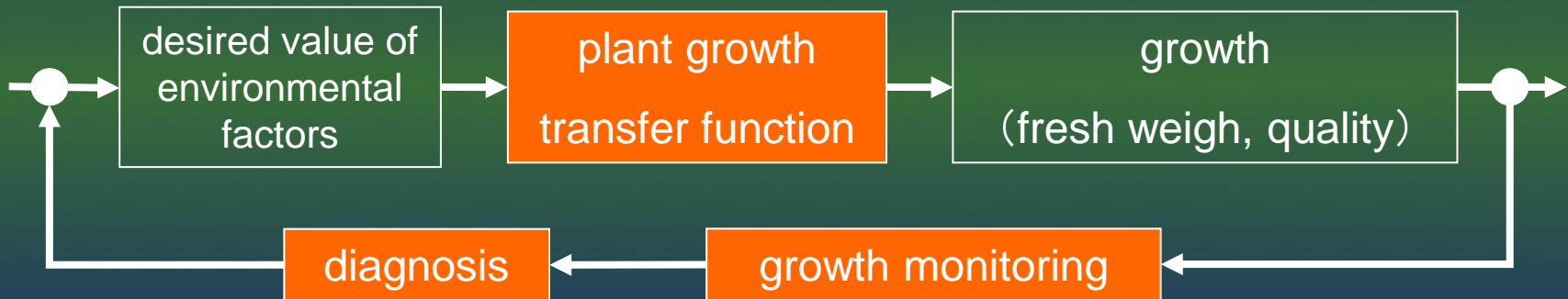
Have the dynamics and diagnosis of plant growth been studied thoroughly?

- There is no index by which plant condition can be measured.
- Environmental factors are adjusted manually according to the condition of plant growth.



Fundamental research themes

- to clarify the relationship between environmental factors and plant growth
- to express the plant growth by mathematical indices



Speaking Plant Approach (SPA)

- It is an interactive method of environmental control.
 - Adequate environments are prepared at appropriate growth stages, according to the condition of plant growth.
 - It is a “**dialogue with plant**”.
- For SPA to be effective, followings are necessary
 - elucidation of **plant reaction** to their environments
 - the development of **technology to measure plant growth**

Conventional method:

adaptation of plants to their environments

SPA:

adaptation of environments to plants



Future vision – advanced environmental control by a computer

How is growth condition?

Lack of light intensity!

Turn on lamp!



- A computer monitors plant growth status through a camera.
- The computer judges what is necessary for plant growth and controls environmental control actuators.



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New stream – production of medical plants and useful substance

The National Institute of Advanced Industrial Science and Technology Hokkaido Branch

- Development of technology used to produce proteins for medical application (e.g. antibodies, some kinds of cytokinins and vaccine compounds) and physiologically active substance by using gene recombination technology
- Production of gene recombinant strawberries used to produce interferon for the treatments of canine diseases

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Strategies to improve the plant factory business

- Reduction of production costs
- Production of high-value added plants

- organized a study group for the next generations of plant factory from 2009 to 2011
- under the Hyogo Alliance of Universities and Colleges for Innovation
- Participation: Kobe University and Mukogawa Women's University

The proposal of the study group

- Target plants is not vegetable but medicinal plants

Study policy on plant factory research

- **Exclusion of edible vegetable as research object**
 - weak business due to high production cost
- **Specialization in production of high-value added medical plant**
 - Percentile of country of origin in total used amount of herbal medicine in Japan: Japan 12 %, **China 83 %**
 - **Rising the price quotation** due to the decrease of medical plant cultivation or harvester in China with bad weather and economic development
 - Internationalization of China medicine raises **the increase of export herbal medicine to Europe and the United States**
 - Rising demand for stable supply of high-quality herbal medicine produced in Japan
 - Possibility of **surplus business by conversion to Sixth industry**

Thank you for your kind attention

A BRIEF INSIGHT INTO THAILAND'S VERTICAL FARMING SECTOR

Dr. René Watteau

Food & Nutrition



สำนักงานนวัตกรรมแห่งชาติ

ให้การสนับสนุนเป็นโครงการ ระดับประเทศ

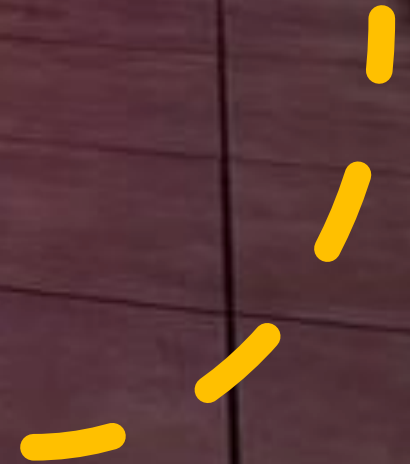


INTRODUCTION



INCREASE OF INTEREST

- Asian countries
- “Plant factory”
- Taxes



MORE DEMAND

- Research projects
- Internet of Things and Artificial Intelligence.
- **Infarm or Farmers Cut.**
- Startup companies

FARMERS CUT

- 'Dryponics' and a retail solution
- Efficient, compact, modular, controllable and flexible
- Local, nutritious, pesticide-free leafy greens in cities independent from external conditions.



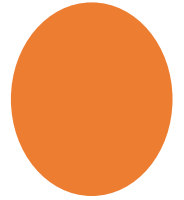
CURRENT INDUSTRY STRUGGLES

- Understand the value of a vertical farming product
- “Post-organic”
- A novel product
- Marketing strategy



FUTURE VISION

- Premium produce for high-end consumers.
- Certification
- Speed breeding and production of medicinal substance
- Other countries : Singapore, Middle East



QUESTIONS, PLEASE.... ?





Unlock the power of plants

Our Mission

Farm3 is an agronomic research accelerator and vertical farm designer for high value plants



Aeroponic technology in a closed enclosure, with climate and nutrition controlled by our Farm3.0 software, to experiment 12 months a year



In-house capacity to design customized production equipment to secure the territory's supply chains



Industrial expertise to deploy ecological and climate-proof plant factories

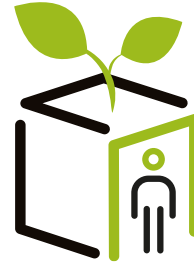


Farm3 takes care of everything



Phenotyping

1. Identification of the problem and the plant
2. Proposal of experimentation by Farm3
3. Validation of a reproducible culture process for a controlled quality



Vertical Farm design

1. Design and/or proposal of adapted production technologies
2. Simulation of an installation allowing the necessary output to the customer and calculation of the ROI
3. Calculation of the ecological impact of the installation



Deployment

1. Turnkey plant deployment by Farm3
2. Customized SaaS to automate the facility
3. Future security of plant supply for the customer

Our SaaS and maintenance contracts ensure the automation and durability of our client plant factories

Notre équipe au service de votre projet

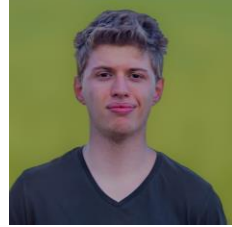
Ils développent l'automatisation et le logiciel Farm3.0



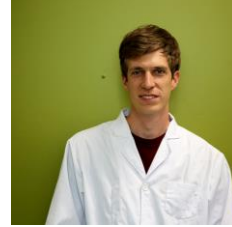
Arthur Bonastre *MSc*
Chef logiciel



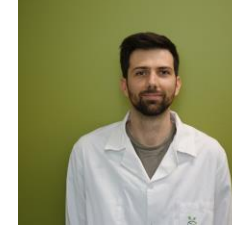
Elodie Casciola *MSc*
Développeuse Fullstack



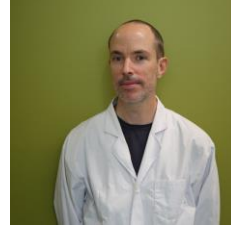
Alexis Boulay *MSc*
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Jérôme Rouault *PhD*
Chef de projets agronome



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Romain Schmitt *MSc*
Co-fondateur
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Co-fondatrice
Directrice marketing

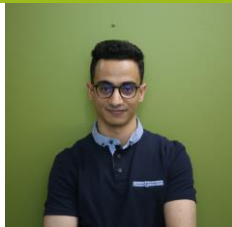
Ils conçoivent et déploient la technologie répondant à vos besoins



Erik Lima *MSc*
Chef opération



Mahamadou Mary
Conception électronique



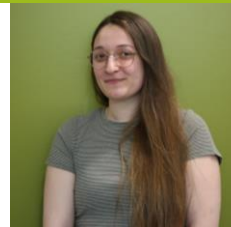
Aymane Nadi *MSc*
Ingénieur mécanique



Emmanuelle Cravo
Chargée d'affaires



Olivia Amouzou *MSc*
Technico-commerciale



Alexie Lustre
Communication

500m2 dedicated to plant experimentation



A proprietary machine
A proprietary software
A unique offer

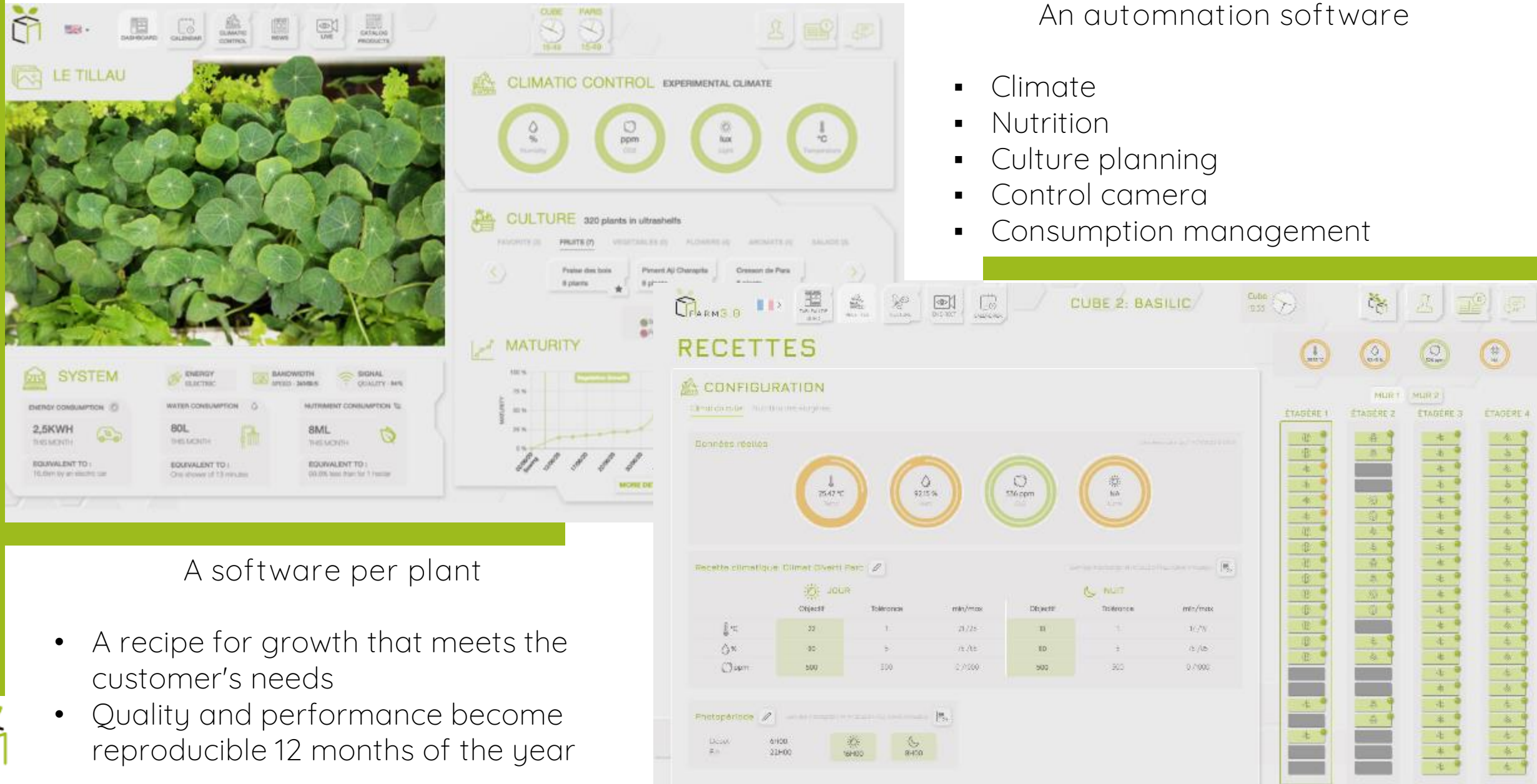


Hundreds of modalities
Thousands of data
Real value creation

FARM3.0 : a customized SaaS

An automation software

- Climate
- Nutrition
- Culture planning
- Control camera
- Consumption management



A software per plant

- A recipe for growth that meets the customer's needs
- Quality and performance become reproducible 12 months of the year

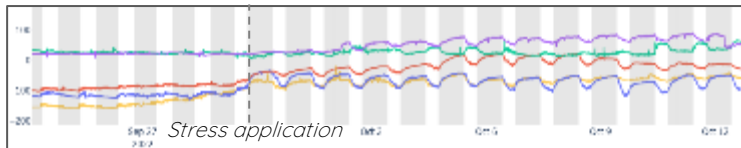
Infinite phenotyping possibilities

Stress study

Drought, temperature, deficiencies ...

- Real-time impact analysis
- Growth routes allowing the development of resistance.

Electrophysiology data revealing physiological impact after stress application



Plant acclimatization process

Screening

Isolation of clones and varieties of interest



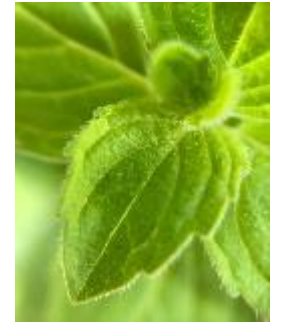
- Jusqu'à 330 échantillons /cond.
- Analyse phénotypique
- Cinétiques
- rendements
- Taux de survie
- Étude de transfert en sol

Qualification of clones of interest

Plant Design

Vitamins, sugars, anti-oxidants, active ingredients

- Promoting the rate of a molecule through a growth pathway
- Comparative study
- High throughput phenotyping
- Spectroscopy and biochemical analysis
- Organoleptic test



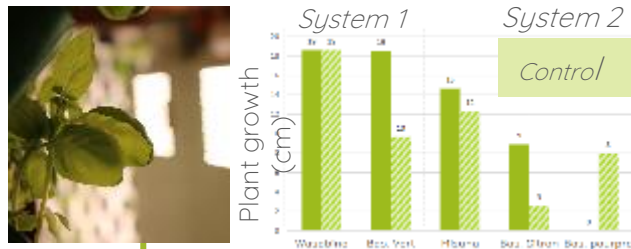
Growth itinerary adapted to your plant

Hardware qualification

Light device, Hvac, sensors, ...

- Analysis compared to a reference
- High-throughput phenotyping

Light installation impact on plant growth



Design consulting

Organic qualification

Biostimulant, fertilizers, substrates, ...

- Comparative analysis of root morphology
- Yield and soil transfer analysis



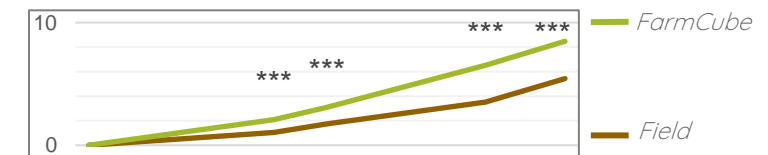
Statistical study of effectiveness

Productivity

Optimizing the profitability of a facility for a target market

- Yield
- Germination success rate
- Soil recovery success rate

Yield of aromatics grown in FarmCube versus soil

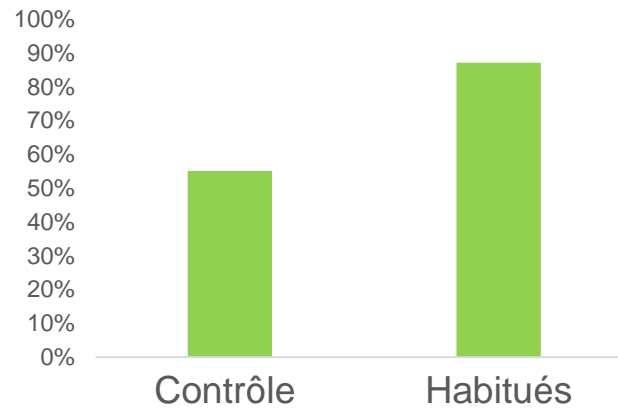


Business plan simulation and adapted pilot plant

Case study: Stress and Resilience

Production of more drought-resistant bare root stock for a Champagne vineyard

- 3 successive climates in 3 months without moving the plant:
 - Stratification
 - Growth
 - Moistening
- Brumisation to put in hydric stress
- Replanting in plot



Survival rate of trained and control vines after water cut-off for 72h

Application for viticulture

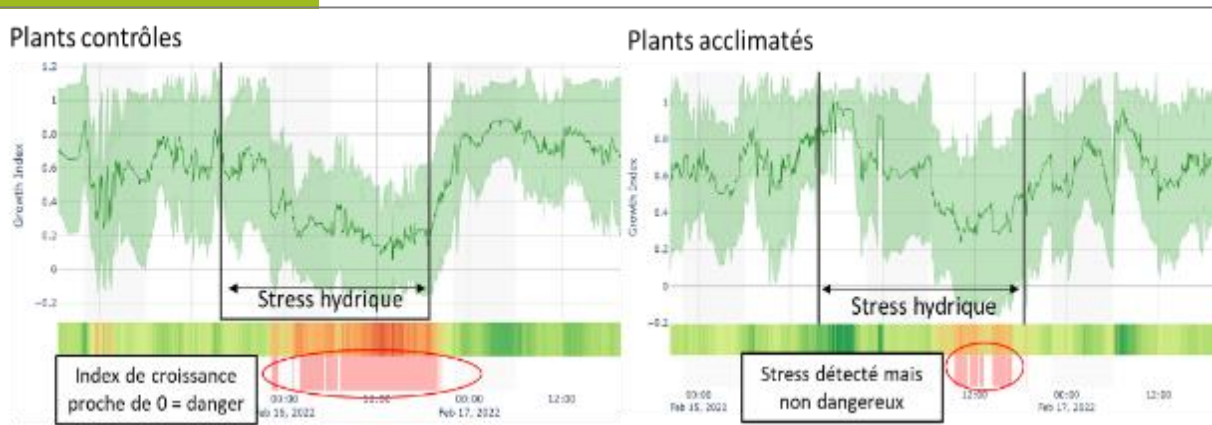


Chardonnay on fercal

Application for silviculture

Real-time visualization of water stress by electrophysiology

Habituation of maritime pine to water stress and soil recovery

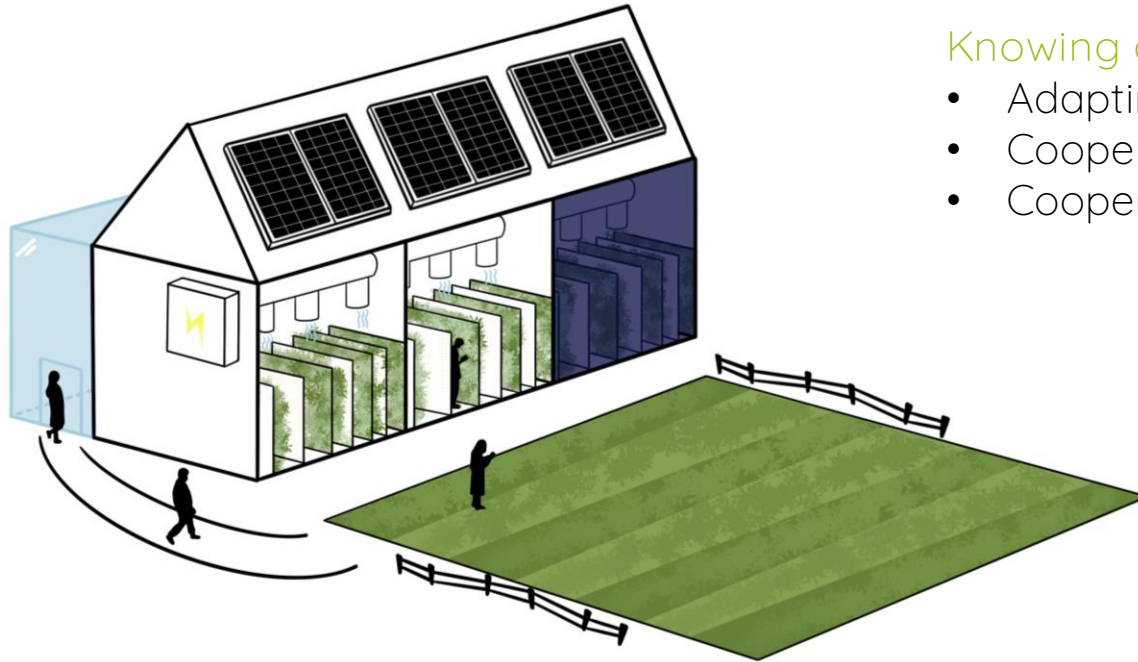


- Jura spring climate
- Germination and rapid growth
- Study also conducted on eucalyptus in-vitro
- Recovery in soil >90%.



Pin maritime

Custom vertical farming for optimum ROI

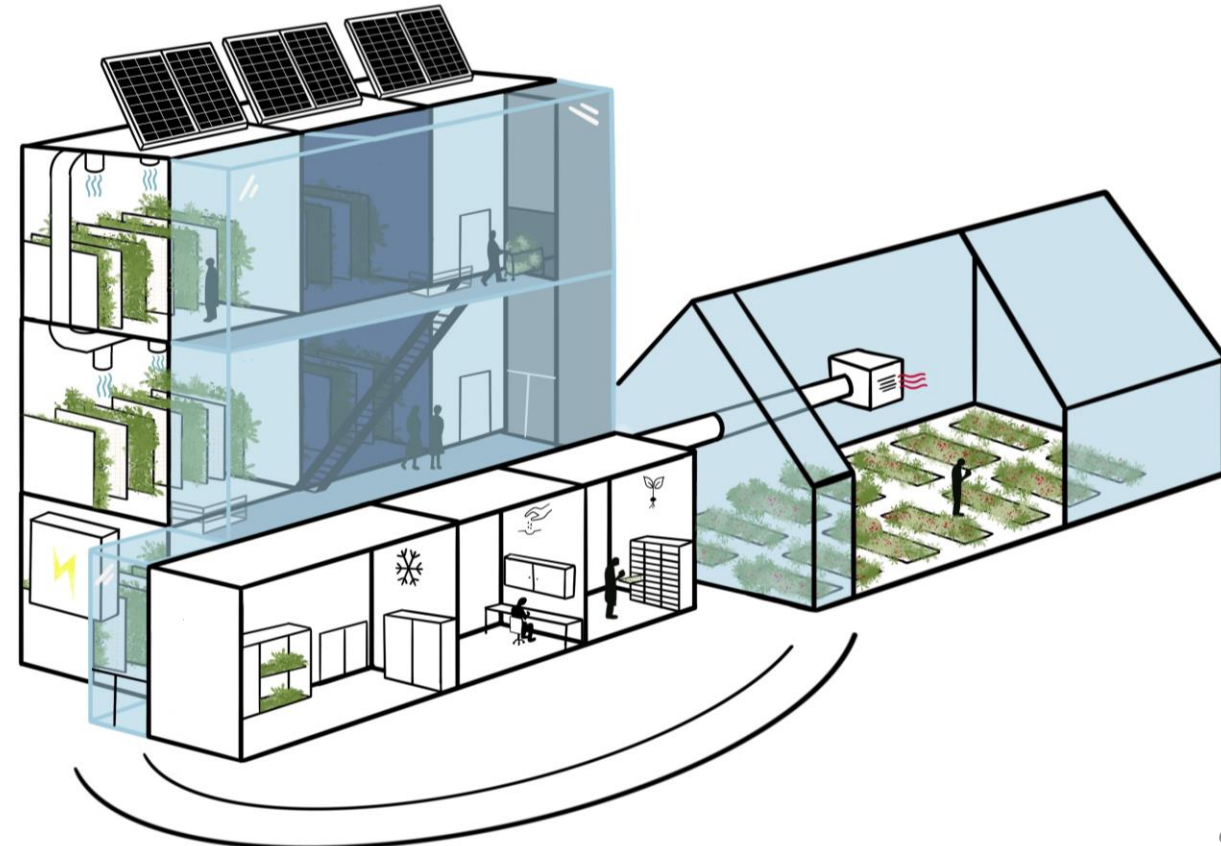


Knowing at what point CEA brings value in the production chain :

- Adapting to existing process
- Cooperation with the field
- Cooperation with a greenhouse





Custom made to fit the client needs:

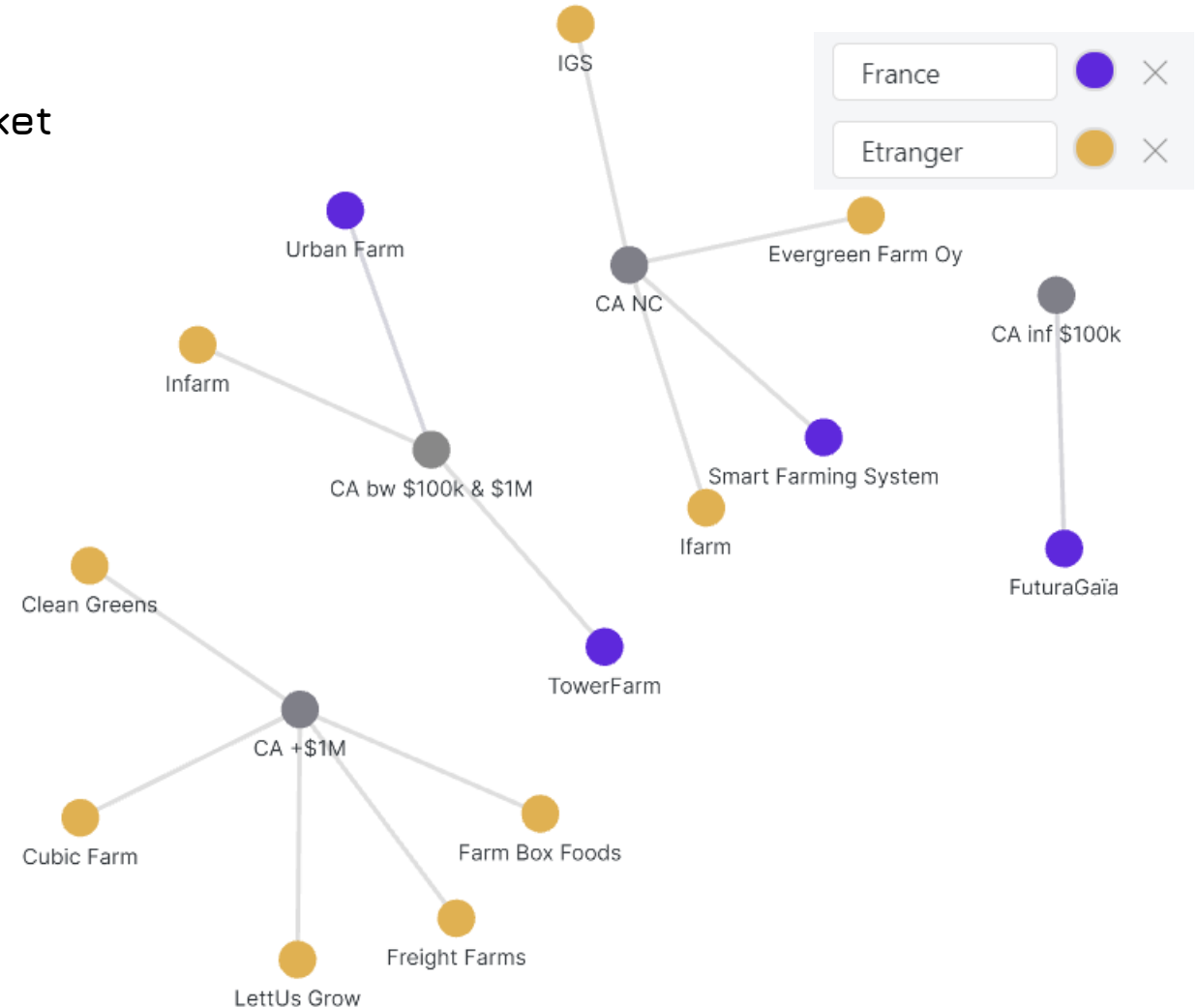
- Optimum climate
- Build for their geographic location
- Ideal yield
- Energetic optimisation with existing infrastructure



CEA companies are multiplying worldwide

Farm3 can help CEA company have a faster market access and easier market penetration

-  The CEAs have been recreating the same agronomic recipes for 7 years without creating new values
-  The angle of food autonomy is for the general public but does not respond to the problem of the market (industrialists and farmers)
-  Focusing on plants with low added value (salad) is, although faster, risky due to low margins
-  By supporting agritech startups to solve market problems, Farm3 opens up competitive and sustainable businesses to startups



Contact:



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www.farmcube.eu



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Unlock the power of plants

Research booster and
production equipment designer

All images © 2019-2023 Farm³

ELIUS

Autonomous greenhouses



WHY?



We want more local
produce



Areas are in danger of
desertification



Healthy food is expensive

Why autonomous greenhouses?

Constant control of growth
environment

Minimal contamination to
finished product

Low transportation
footprint

Reduced water
consumption

Challenges

Climate control



Keeping a certain temperature inside the container but maintaining a high Co2 level

Energy consumption



How can we reduce energy consumption but still produce a high-quality product

Automation



Automatic seeding and harvesting will be added after the first prototypes.

Business model / leasing model

Monthly subscription

Low upfront cost

Only 6 months binding

ARIAN  **TECH**

Build your dream farm

Bringing Urban Farming to new heights

Speaker: Edwin Ong (ARIANETECH PTE LTD)

Date: 21st September 2023

Time: 0900 – 1100 CET



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Profitability of Urban Farm

04

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Potential challenges
during implementation

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OUR COMPANY

Arianetech specializes in the research & development, manufacturing of modern agricultural technology and equipment. With our own unique advanced technology, we are able to provide total agricultural solutions for urban farm growers.



OUR VISION

Creating opportunity and
growing the future for
sustainable urban farming



ARIAN  **TECH**
Build your dream farm



01

URBAN FARMING

Introduction

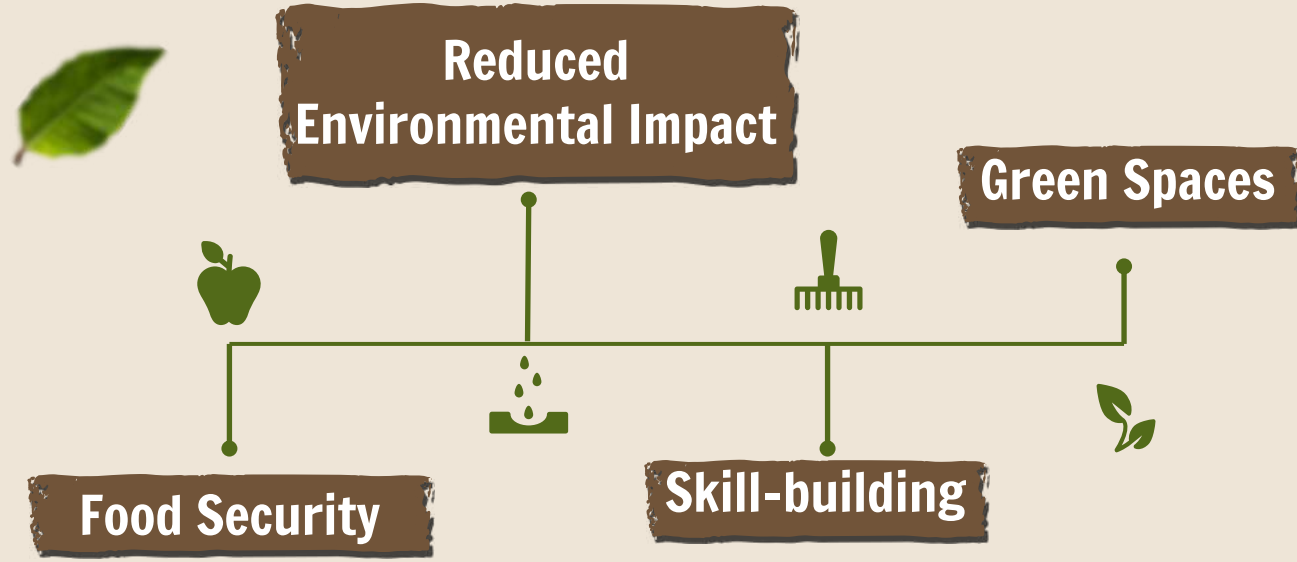


What is Urban Farming ?

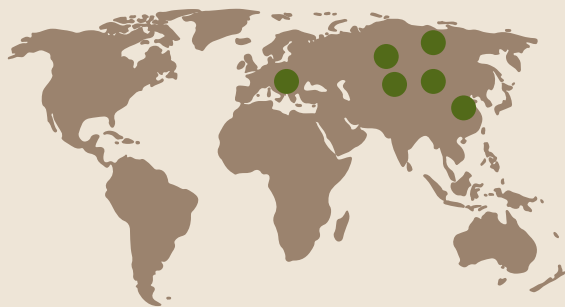
Forms & Scales



Benefits



02



Global Scale down of Urban farms

Possible Reasons

High Operating Costs

Higher energy cost, increased labor costs, and the need for specialized infrastructure

Lack of Resources

A lack of continue funding, access to agricultural expertise, or technical support can make it difficult to sustain and scale these projects

Market Challenges

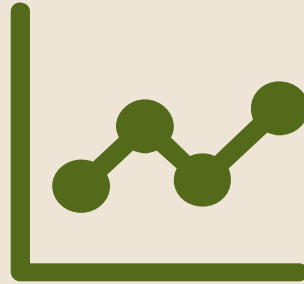
High cost of production affects the price to sell which makes the produces unable to compete with traditional farms

Limited Scalability

Expanding operations may require substantial investments in infrastructure and technology.

03

Factors affecting Profitability of Urban Farm



Operating Expenses (OPEX) driver

Energy Costs



Labor Costs

Space Costs



**Marketing &
Distribution**

04 Mitigating Solutions & Challenges



Operating Expenses (OPEX) driver

Energy Costs

Mitigation: Implement energy-efficient technologies such as LED lighting systems & renewable energy sources

Challenge: Unpredictable energy prices; High upfront costs for energy-efficient equipment and renewable energy installations



Labor Costs

Mitigation: Invest in automation and mechanization, provide training & incentives for skilled workers

Challenge: Initial investment in automation can be expensive. Finding skilled labor or volunteers can be competitive

Space Costs

Mitigation: Efficient space utilization, technology adoption and collaboration

Challenge: Navigating regulatory hurdles, competition, and market access issues

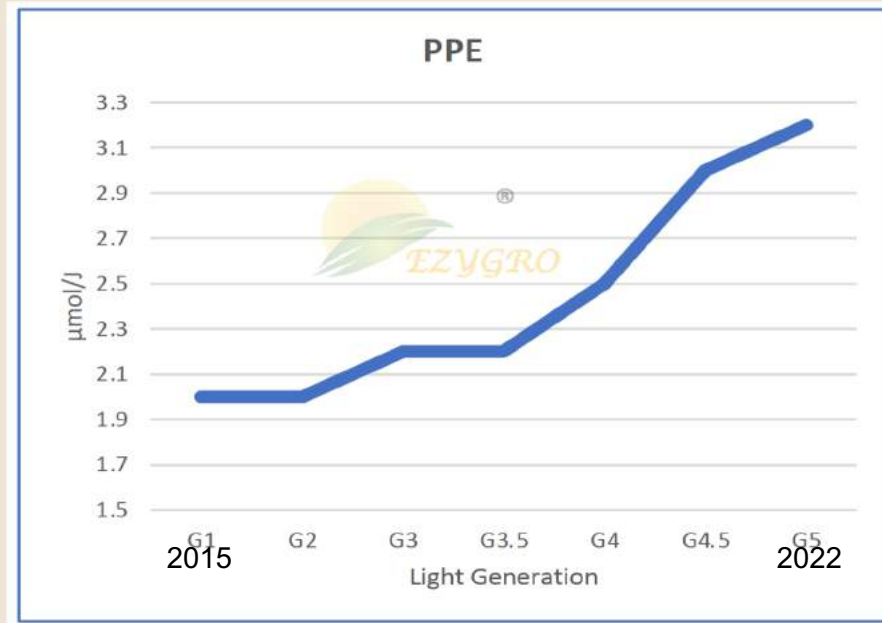


Marketing & Distribution

Mitigation: Develop cost-effective marketing strategies, such as social media promotion and local partnerships

Challenge: Building a customer base and maintaining effective distribution can take time and resources

Energy Consumption in ARIANETECH



Automation Technology in ARIANETECH



Space Utilization in ARIANETECH



Projects collaborated with ARIANETECH



Currently, we have been working with more than 25 indoor farms and Research Institute in Singapore and abroad and have also offered our technologies and products to Countries around the world such as Japan, Indonesia, Thailand, Malaysia, Philippines, Mongolia, US and many more.



Projects collaborated with ARIANETECH



NIIMI MENTEC BLUEBERRY PLANT FACTORY (JAPAN)

With our LED grow lights, our client NIIMI MENTEC in Okayama, Japan, is able to grow bigger blueberries in a shorter cycle, while increasing the production of anti-oxidants content. Also increased sweetness. We received great feedback from our clients and the project expanded the following year.



PANASONIC VERTICAL INDOOR FARM (SINGAPORE)

Partnering with Panasonic to establish the first large scale indoor farm in Singapore.



Projects collaborated with ARIANETECH



AQUA GREEN ADOPTED EZYGRO LED GROW LIGHT USED IN THEIR INDOOR HYDROPONIC VERTICAL FARM

Aqua Green chose our 4th generation EZYGRO LED grow lights and our Premium Hydroponic NFT Duct used in their hydroponics system. With specialised Red and Blue spectrum, EZYGRO delivers high PPFD to simulate the growth of crops



NATIONAL UNIVERSITY OF SINGAPORE- DEPT. OF BIOLOGICAL SCIENCES

Arianetech is honored to provide the complete city indoor farm plant factory equipments & system to National University of Singapore-Dept. of Biological Sciences . With our SmartAgro system, our client are able to grow various different plants like leafy vegetables and fruits.



Projects collaborated with ARIANETECH



REPUBLIC POLYTECHNIC AGRI- TECHNOLOGY LABORATORY

Arianetech was honored to be selected to design and supply three different types of indoor vertical farming system



TEMASEK POLYTECHNIC LIFE SCIENCE PROJECT-INSTITUTE OF HIGHER LEARNING

ARIANETECH was honoured to supply the lights to be used in Temasek Polytechnic's bioscience research project



ARIANETECH
Build your dream farm



05

Conclusion



THANKS!

Contact us Today!

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Fax: (65) 6779 5730

E-mail: enquiries@arianetech-sg.com

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