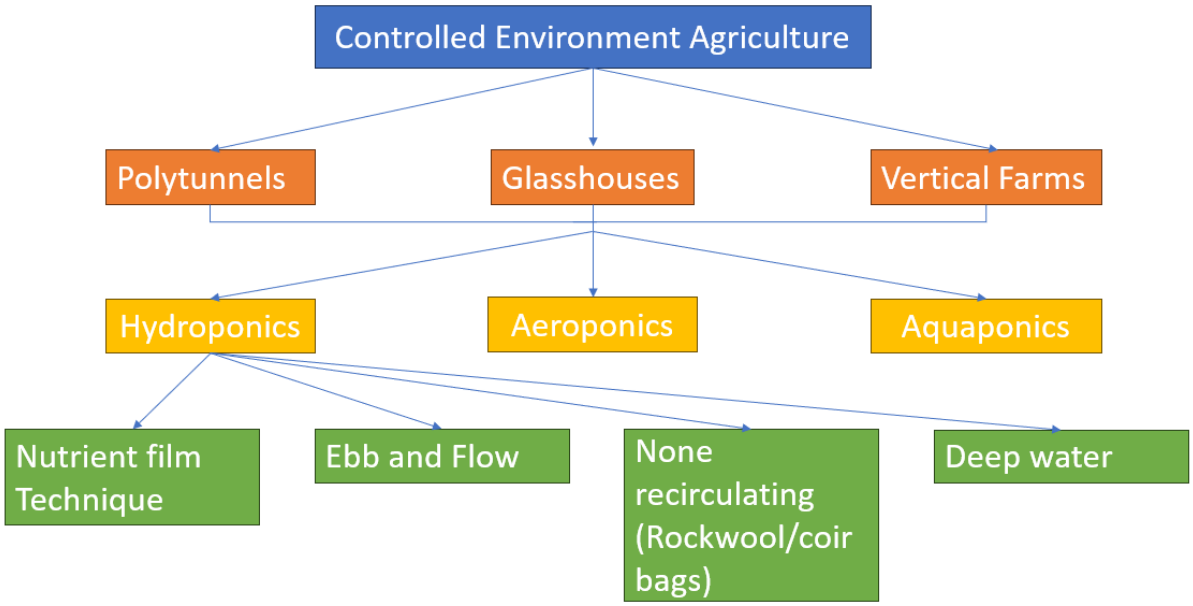
Incorporating Controlled Environment Agriculture into your existing business model

FACTSHEET

DEFINITIONS

Controlled Environment Agriculture (CEA)

- A technology-based approach toward food production. The aim of CEA is to provide protection from the outdoor elements and maintain optimal growing conditions throughout the development of the crop. Production takes place within an enclosed growing structure.
- Hydroponics
- The process of growing plants without soil in beds of sand, gravel or similar supporting material flooded with nutrient solutions



WHY GROW INDOORS AND WITHOUT SOIL?

Advantages

- Soil quality not important
- Soil pests and diseases more manageable
- Can grow in urban or peri-urban areas
- Not as weather dependent
- Easier programming
- Stable labour requirements
- Potentially good returns on investment
- Strawberries get around double the polytunnels

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Disadvantages

- Higher capital set-up costs
- Potentially higher operational/running costs

GROWING ENVIRONMENTS: NATURAL LIGHT

Cold regulation will improve as your growing structure gets more advanced.

Outdoor (1 or 2 fleeces)	Polytunnels (can still use fleeces)	Multi-spans (multiple thermal screens)
	 	 

GROWING ENVIRONMENTS: NATURAL LIGHT

Advantages

- Outdoor: minimal investment in infrastructure
- Polytunnels: cost-effective structures that offer significant yield improvement and season extension
- Multi-spans: superior environmental control improving production

Disadvantages

- Outdoor: limited seasonal control
- Polytunnels: harder to control temperature
- Multi-spans: higher initial investment requirements

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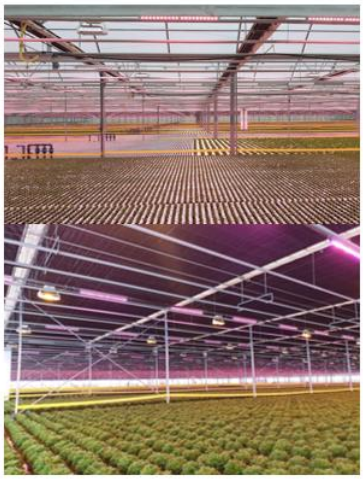
GROWING ENVIRONMENTS: ARTIFICIAL LIGHT

Temperature and humidity regulation improves as your growing structure gets more advanced.

Polytunnels	Multi-spans	Vertical Farms
(can automate side ventilation)	(automated top ventilation)	(requires HVAC climate control)



Advantages

- Polytunnels: Better value lighting
- Multi-spans: Better value lighting, can add CO2 and heat
- Vertical Farms: Small footprint (stackable), not affected by weather, perfect programming, short winter supply chain

Disadvantages

- Polytunnels: Hard to control temperature & humidity
- Multi-spans: Some effects the seasons
- Vertical Farms: High Capex & Opex, must co-invest in renewables, can add CO2, few premium prices

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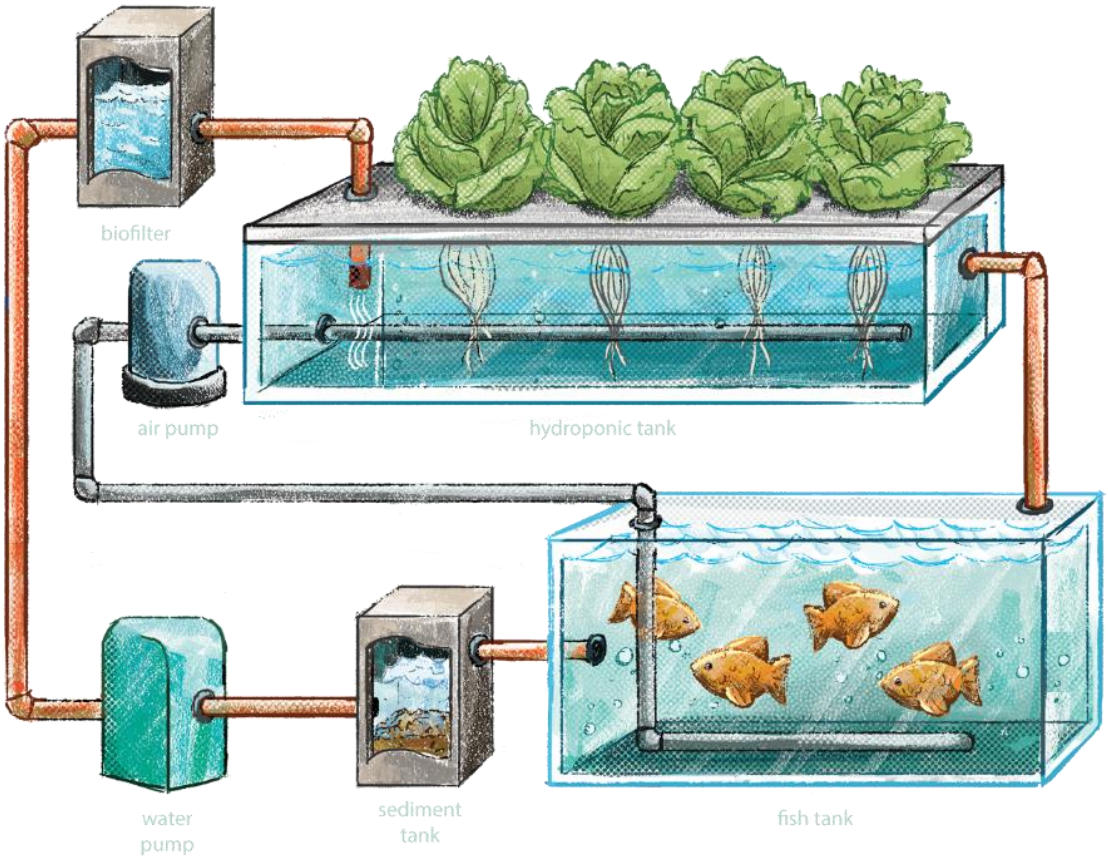
AQUAPONICS



Advantages

- Getting two crops for the price of one

Disadvantages

- Requires a ready local market for fish
- Fish food is a large cost center
- Requires additional skills training in fish farming
- Not easy to balance the nutrient load for the crop
- Fertilisers are relatively cheap so not a large cost saving for the hydroponics

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AEROPONICS

Advantages

- Good root crop aeration
- Reduced need for growing media after germination
- Lowest water volume requirements

Disadvantages

- Limited residual water holding capacity if irrigation system fails
- Potentially high energy requirements

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HYDROPONICS: NONE RECIRCULATING

Advantages

- Soil pests and diseases more manageable
- Some growing media can be use to enrich soil (coir for strawberries and raspberries)
- Easier to administer nutrients than circulating systems
- Easy to crop walk

Disadvantages

- Some growing media ends up in land fill (rockwool for tomatoes and cucumbers)
- Slightly higher water volume requirements

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HYDROPONICS: NUTRIENT FILM TECHNIQUE (NFT)

Advantages

- No need for any growing media after propagation
- Lower water volume requirements
- Easy to clean grow troughs
- Potential easy to crop walk

Disadvantages

- No residual water holding capacity if irrigation system fails.

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HYDROPONICS: DEEP WATER

Advantages

- Lots of residual water in the system
- Cost-effective over large areas
- Potentially easy to crop walk

Disadvantages

- Floating trays are often plastic (reusable)
- Not stackable

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HYDROPONICS: EBB AND FLOW

Advantages

- Easily stackable
- Potentially easy to clean (depending on system design)

Disadvantages

- Some water holding capacity depending on the growing media
- Potentially hard to crop walk

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AGRONOMY

Not 100% automated systems

- Some verticals pressure positive
    - Aphids, flea beetle, etc
    - Botrytis, Rhizoctonia, pythium
- Suppling all the plants needs

Crop walking

- IPM/bio security
- Hygiene
- Nutrient management planning
- Growth stages

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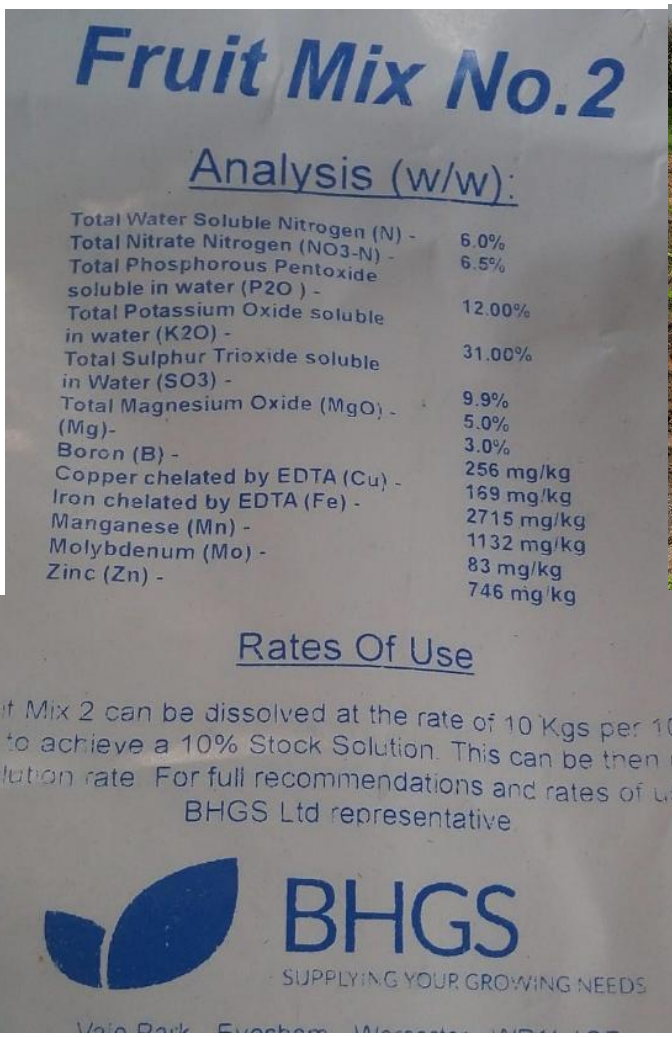
FEEDS, MIXING AND DELIVERY SYSTEMS



Feeds

Proprietary

- Straights and recipes
- Injectors and diluters

Water

- Analysis and source
- Alkalinity and pH
- Storage
    - Rainwater harvesting

Irrigation systems

- Pumps and timing
- Target EC based on water hardness

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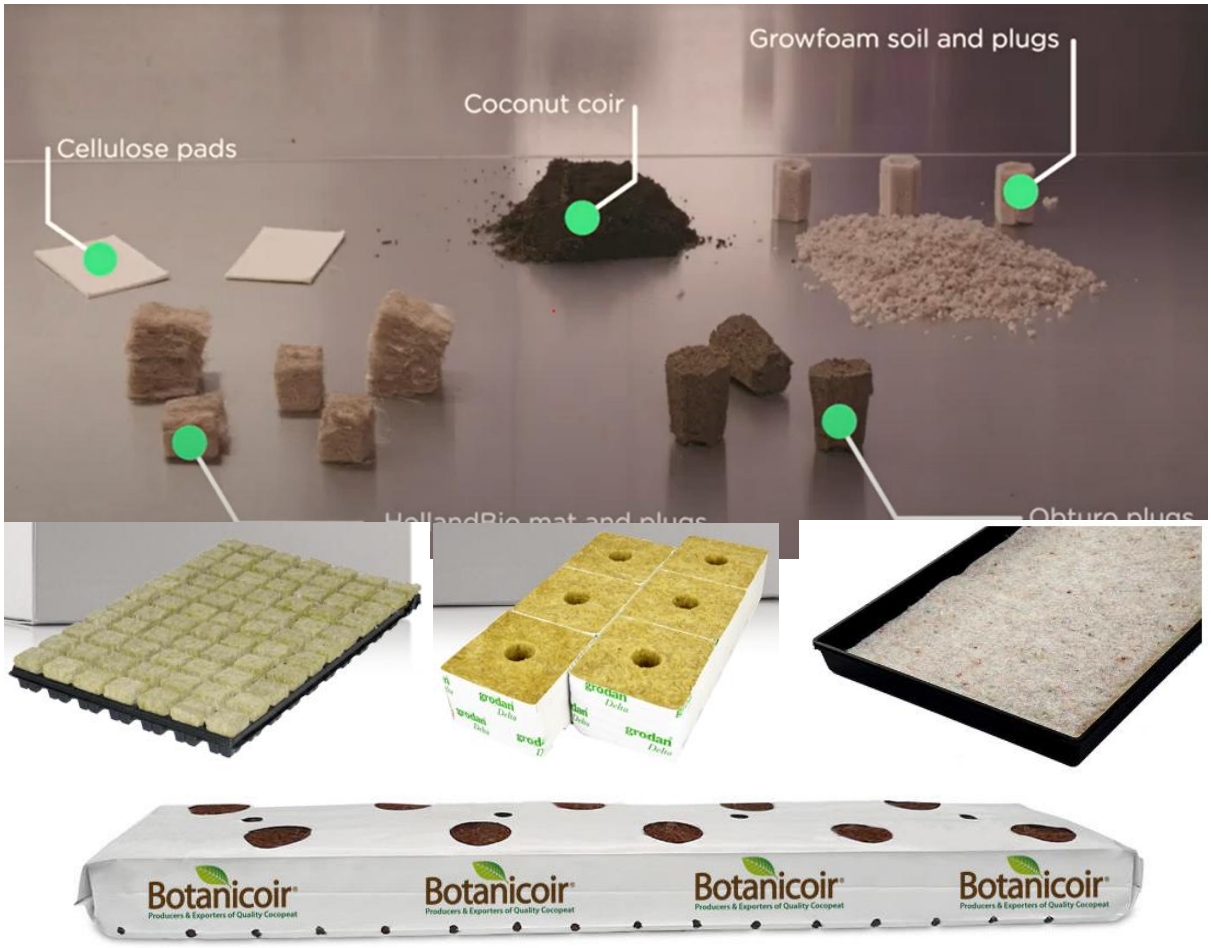
GROWING MEDIA



Advantages

- Some are bio-degradable
- Soil type not an issue
- Soil pests and diseases more easily manageable

Disadvantages

- Rockwool and growfelt go to landfill
- Coir comes 7,500 miles
- Algal growth for longer growth periods

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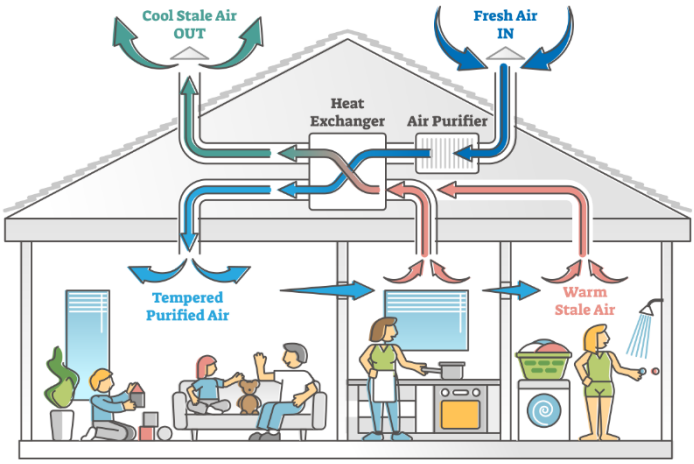
HOME MADE INNOVATIONS



No usable natural light in a stacked system so put insulation around the outside

Keep Capex and Opex down

- Combine with MVHR instead of air conditioning
- Consider single-layer and top lighting
- Convert existing buildings
- Link to renewables

Niche use

- Fill production gaps
- Propagation

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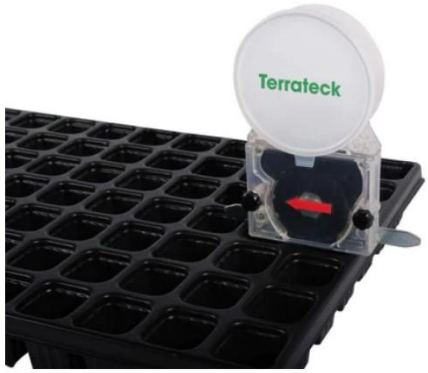
PROPAGATION



Programming for continuity (production plan timings)

Technical

- Separate propagation area with specialist equipment
- Light only required after emergence
- Optimal humidities, often 95+ %
- Optimal temperatures
- Optimal sowing densities

Automated seeding options are available

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GROWING ON

Crop management

- Daily management
    - EC levels, temperature, humidity, CO_2 , crop specification, grow plan adherence
    - Runner removal, pinching, de-leafing
- Crop walking
    - Colour, health and growth type
- Skills and training

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RESILIENCE

Critical systems

- NFT – irrigation (can be dead in hours)
- Coir bags in none recirculating – irrigation (can least half a day
- Vertical – all systems

Systems management

- Backups needed
    - Generators, pumps, water storage, plant storage
    - Boiler alarms
    - Irrigation alarms – especially for timings in the nig

TIMING/CONTINUITY

Timing crops to get the most of your system

- Know your grow days at different times of the year

Most markets prefer predictable supply

- Predictions must be accurate
- This includes your yield
- Accurate yields mean less over production and saves cost
- Propagation of lettuce in a greenhouse
    - December: 2 months
    - May: 4 weeks
- The more technology the more accurate your crops

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PESTS AND DISEASE (IPM)

Monitoring

- Coloured sticky traps
- Pheromone traps

Insects

- Aphids, shore flies, spider mites, flea beetle

Pathogens

- Pythium, phytophthoras, rhizoctonia, botrytis, mildews

Treatment

- Pesticides, bio-protectants, bio-controls

Indoor farming are still vulnerable systems!

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HARVESTING

Improves labour efficiency and saves time

- Strawberries 25-30% quicker

Timing for optimal yield and grading size (specification)

Easier training, monitoring and traceability

Shorter supply chains improve shelf life

- Season extension
- Reduced logistics

Possible to mechanise some crops

Salad production

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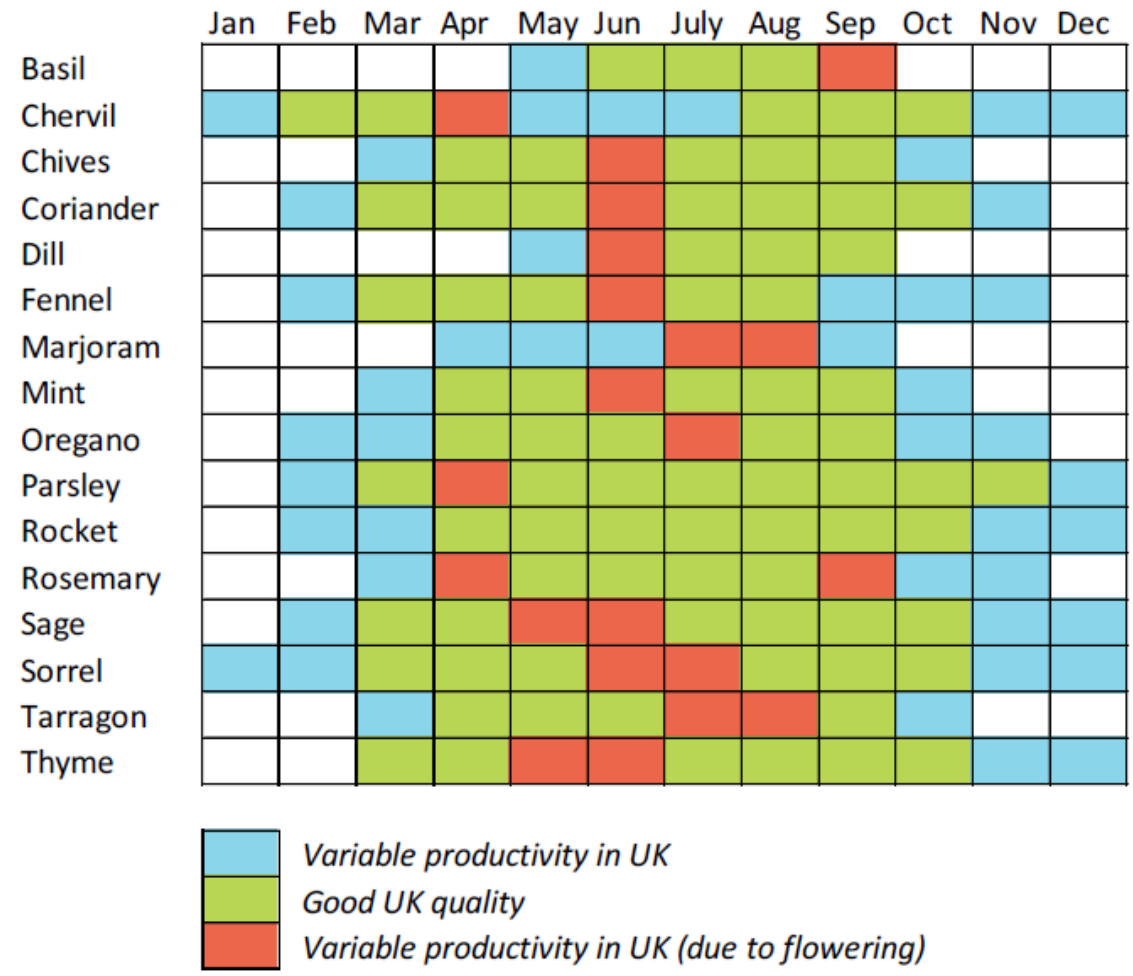
BUSINESS PLANNING



On possible approach is to target months when the market is short

- For example its possible to use a CEA system to target the blue and red months
- As prices could be higher in this period due to reduced British production

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VERTICAL FARM CAPEX/OPEX

Farm size (m^2)	Capex low estimate (£/m^2)	Capex high estimate (£/m^2)
1-50	500	1000
50-100	1000	4000
100-500	1000	3000
500-2000	1200	2500
2000-10000	1500	2300

	£/m2/year
Revenue from sales	629
Cost of lighting	73.58
Cost of HVAC	46.78
Cost of staff	433.33
Cost of occupancy	261.00
Cost of consumables (UKUAT estimate)	50
Total of main costs	864.69
Rough profit/loss	**-235**

Few growers investing in vertical

Mostly from venture capital funds

Structures utilising natural light can be more cost effective

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MARKETS

Supermarkets

- High demand, but low prices

Smaller local supermarkets (Spar, Nisa, etc)

- Local managers have a say, could build a brand

Wholesale Markets

- Some specialist suppliers, seasonal prices

Direct Sales (promote with social media)

- PYO, Veg boxes, Farmers Markets, Box Schemes, restaurants
- Premium prices

FURTHER QUESTIONS?

Ben Barnes and Chris Creed are available for one-on-one advice via Farming Connect

BY BEN BARNES AND CHRIS CREED, ADAS

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