Agri-TechE

Controlled Environment Agriculture: The Industry is Growing Up

Event report

KEYNOTE SPEAKER

How feasible is vertical farming for feeding the cities of the future, and how can knowledge of CEA become integrated into urban design? Could this result in a more efficient and effective system with which to provide fresh food, grown in the city to feed its inhabitants, asks ***Luuk Grammens*** *of University Research Wageningen in a session chaired by NIAB's* ***Dr Lydia Smith****.*

In summary, Luuk's doctoral research shows that one size doesn't fit all - the efficiency of the production system depends heavily on location, climate and design of the growing system. This in turn affects the efficiency and costs, which directly influence the technical and financial feasibility.

Resource use efficiency (RUE) of food production in "plant factories" is a function of:

- System design
- Illumination
- Crop response
- External climate

These parameters have been modelled based on data from high tech greenhouses and closed system vertical farms, based in Sweden, Amsterdam and Abu Dhabi (chosen for their differences in climate, energy provision, water availability, day length and light intensity).

By calculating how much energy, CO_2, water, and land area is required to produce 1kg of dry weight crop in the different locations, it is possible to establish the viability of vertical farming systems in these contexts.

Every location and context will require optimisation of the design, with different climate zones informing whether vertical farming will be a reasonable alternative, and whether it is economically possible to cost-effectively provide adequate water, power and climate control to manage a closed system. Another factor is consideration of the land area needed to produce the same amount of food, given local conditions and constraints.

In moderate areas, it is unlikely that vertical farming can outperform greenhouses, however, these insights enable city planners to base future plans using the knowledge we have on the food system side and start producing for the city, in the city, in the most efficient way.

Key points from the Q&A

- The significant collaborations between researchers, growers and government in the Netherlands is helping to establish a proper knowledge, technology and financial infrastructure to ease the capital costs of setting up VF systems.
- There is a lot of activity in the Netherlands around breeding new varieties to gain better Resource Use Efficiency in a closed system – for example to grow in higher production temperatures and higher light intensities.
- While based on lettuce, Luuk's research also considered fruit and different types of greens – this work is as yet unpublished.
- Pesticides are likely to still be needed in vertical farming systems – designing systems with a series of compartments to limit the spread of contamination is key.
- A promising area of research is how to control production systems to manage specific biological processes to manage flavour, nutrition and even shelf life (there is some evidence that a higher dose of blue lights given towards the end of the growing terms can potentially extend the

Is It Too Late To Start-Up And Scale?

The scale of global capital flow into CEA and vertical farming companies has been described as "eye-watering" and analysts are keenly awaiting the major exits and return on investment. This session focuses on the potential for new innovations for CEA and explores the existing investor appetite, possible routes to market and the potential to go "beyond babyleaf" as a start-up. ***Chaired by Niall Mottram, Cambridge Consultants)***

Lettus Grow, led by Jack Farmer, is a specialist aeroponic horticulture-tech company, aiming to lead in the container farming space using "drop and grow" containers.

Kate Hofman is the co-founder of Grow Up Farms, growing ethical, nutritious food in sustainable controlled environment since 2013. She sees the energy and technology revolutions coming together to deliver better food more cost-effectively for consumers.

Mike Davies of Eider Investments sees vertical farming as a way of aligning the Sustainable Development Goals with the investment portfolio. He sees a lot of opportunity to reduce electricity costs, and increase automation, eliminate biohazards and further reduce production costs.

Ande Gregson founded Greenlab in 2013, a co-working space to bring together food and pharma production in controlled environment. He is currently looking at off-grid solutions and is aiming to test solutions which can deliver value to a growing business at scale.

Topics of discussion included:

- CEA has been dominated by premium value produce – to scale effectively, the location of the business (to source high quality talent) and proximity to a customer base is key to helping manage costs and increase volume. A "premium" label does restrict the market potential.
- The importance – or otherwise - of the "organic" label to enable CEA to be economically viable – CEA needs to be viable without the premium prices. Soil-based organic production shouldn't be seen as a polar opposite of CEA. A sustainable food system – linking back to Luuk's presentation – should use the best of both.
- Consumer appetite could be influenced by the inclusion of a new "carbon footprint" metric – with a traffic light system potentially influencing purchasing behaviour.
- The ethical issues of CEA versus soil-based production in, for example, peatlands, or areas which can be "re-wilded" – the crucial point is to grow the right crops in the right place using the most appropriate technologies. CEA can bring automation which can help reduce production costs and reduce the reliance on labour – a holistic, case-by-case approach is needed as in some cases there may be an argument for CEA production helping prevent pollution, soil erosion etc.
- There is increasing interest from investors about sustainability and long-term infrastructure aspect of CEA – which is viewed as long life asset.
- Collaboration between different providers is critical for CEA and there are different ways to get into the market depending on expertise – tech providers, infrastructure providers eh irrigation, LED technology, scientists with crop & horticultural expertise
- Gaining traction from government for funding is critical – it's important to be speaking the language of the government and framing the business case for CEA accordingly. Brexit may well force market dynamics so that government pays more attention.

Connecting with citizens: vertical farming and social innovation

Changes to the global agri-food system are urgent and inevitable. The shift in mindset from "consumers" to "citizens" is seen by some as a way of providing more effective insights into the food system and how to expand engagement. This session explored the potential role of vertical farming within the future of food production.
Chaired by Anthony Gardiner, G's Fresh

Andrew Johnson is an innovator, disruptor environmentalist, former large scale salad producer and has developed a home-based automated production system, GenGROW, for the new "hunter-gatherer" of the 21st Century. With a home-based unit and a subscription model to deliver seeds and other consumables, the GenGROW system has the potential to deliver against the Sustainable Development Goals, reduce food waste and provide an integrated system for food production in the home setting.

Vertical Future, a technology and R&D company is led by **Jamie Burrows**, and is building hardware and software solutions, with a strong emphasis on automation. They see vertical farming as a tool to use in suitable areas, rather than a silver bullet. With most of the technology designed in-house, with key collaborations around seed treatment and sensors, most of the partnerships are with UK companies.

With a portfolio of projects around phytopharmaceutical and fodder crops, a wide customer base of restaurants, catering companies and homes, Vertical Futures has also developed "Diana" – a Software as a Service products using RFID tracking. A collaboration with HECK is also leading to a vertically integrated facility to produce locally and at scale, with a focus on nutrition to select key ingredients for the new HECK product ranges. A collaboration with NIAB and Zayndu is enabling access to heirloom babyleaf variations for CEA production.

Method Europe Ltd is a design consultancy led by John Oswald, which has developed a version of the MIT Media Lab's Personal Food Computer. The concept is a series of modular hydroponic growing environments which could be connected with each other and across the general grid, so users could potentially share recipes and growing experiences.

The Food Computer was used to explore what food futures might look like, based around 3 scenarios:

- Consumers eat tailored food for our individualised needs?
- Food us supplied via a "fairness co-op" - all have the same things to eat but had new rituals to celebrate the act of eating?
- All consumers have personal food computers at home?

The aim was not to think about VF as a viable technology, more to consider how to change the system and what this means for the urban environment.

Mira Meme is an agricultural entrepreneur using technology as an enabler via the "One Farm" concept - to provide security affordable environmentally friendly food supplies with lowest footprint possible in all areas. Spent 4 years researching substrates, seeds, LEDs HVAC systems,

The aim is to localise multi-crop systems for local use, recycle resources and use less arable land (the system can produce 1000 tonnes of food on 5000 m^2). The business model is a remit of a basket of crops to localise veg, protein, berries, herbs, salad, brassicas etc. produced via a hub of farms that

Current long supply chains are unreliable, expensive and carbon intensive so One Farm aims to bring as much production as possible indoors, cutting costs via larger infrastructure and making food more affordable. An education programme alongside is enthusing young people around indoor agriculture.

Current limiting steps include the planning process, especially the redevelopment of large-scale sites in densely populated areas. However, they provide employment and education etc, and can potentially be integrated into office blocks and large scale housing projects.

What future change would you like to see?

- Better regulation around home production, and development and implementation of technical standards
- More investment, better collaboration between growers.
- Government input on price – a government subsidy could incentivise this as a health initiative.
- More open source sharing - this has been effective in the IT industry, demonstrating higher quality and greater outputs.
- Greater consumer awareness and education around food, and better educational content in schools and on products.

If members would like to receive the link to the full event, please get in touch.