



Circular Food Production in the City: Aquaponics Provides Food for Local Markets

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Key messages

- Commercial aquaponics represents a new agriculture option for Europe's cities and has a large market potential.
- Capturing the potential of commercial aquaponics in the urban environment requires international cross-sector collaboration between urban farms and technology providers.
- This *Insight* discusses how GrowUp Urban Farms built the UK's first commercial urban farm, applying a closed-loop production system to produce greens (salads and herbs) and fish.
- Compared with conventional methods, GrowUp's aquaponics reduces greenhouse gas emissions associated with food production and distribution in east London.
- The case illustrates how, with proper design, it is possible to scale up aquaponics in an urban environment.

Introduction

In the European Union, 75 per cent of the population lives in towns and cities,¹ where people consume a considerable amount of resources. Kate Hofman, co-founder of the London-based enterprise GrowUp Urban Farms Ltd, works with her team to revolutionise urban food production and contribute to feeding city residents more sustainably. In 2015, the GrowUp team established Unit 84, the UK's first commercial urban farm. It uses a closed-loop production system based on aquaponics and vertical growing techniques

to produce fresh leafy salads, herbs and fish. Aquaponics combines hydroponics (growing plants in water without soil) and aquaculture (fish farming), see Figure 1.

Unit 84, located in an industrial warehouse in London, is designed to meet commercial demand for sustainably and locally produced food year-round. GrowUp's aim is to reconnect consumers with the origins of food and deliver a transformative impact on climate change. The system reduces greenhouse gas emissions compared with conventional salad production and fish farms by optimising

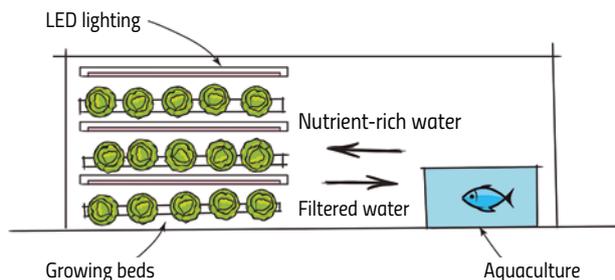
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Figure 1. Principles of aquaponics, an efficient technology that cycles water from fish tanks through soil-less growing benches for plants and back again



Source: GrowUp Urban Farms

resource use; for example, by having minimal heating requirements and using renewable electricity through green tariffs.

This *Insight* presents a case study on how the Climate-KIC start-up GrowUp Urban Farms developed the first commercial urban aquaponics farm in the UK using a closed-loop approach. The case was singled out by WiseEuropa, an independent think-tank, as an example of applying circular economy principles at the nexus of urban resilience, food production and land use. WiseEuropa believes GrowUp's approach sets an example for entrepreneurs launching their own climate-related ventures, particularly in Central and Eastern Europe, where securing funding and managing stakeholder cooperation, including regulatory bodies, remains a challenge.

The GrowUp story

GrowUp Urban Farms is the first company to establish a commercial urban aquaponics farm in the UK. In 2013, aquaponics businesses were just starting in Asia and North America,² but there was no large-scale urban aquaponics production in the UK. Grow-Up's initial demonstrator, the GrowUp Box, was crowdfunded by more than 300 people as a Kickstarter project in 2013 and installed in Roof East, Stratford, London in 2014. GrowUp Urban Farms was established in 2013 and incubated by Barclay's Bank and Climate-KIC's Accelerator programme, a leading European business incubator scheme. It received early funding of around €90,000 from Climate-KIC to support early stage design of Unit 84, then raised £1.25 million seed investment from Innovate UK and Ignite Social Enterprise in 2014. One year later, Unit 84 was constructed in Beckton (see Figure 2).

Due to lack of a precedent in the UK, the GrowUp team had to break fresh ground regarding Unit 84's technical construction and regulatory compliance. GrowUp worked

with various suppliers to design and deliver the farm in a pre-existing urban warehouse. The cross-sector build team was assembled partly through the founders' personal and professional networks and partly through companies with which GrowUp had come into contact over the previous years through press exposure and industry research. GrowUp's management team acted as the project manager and technical integration lead. The company had to combine solutions from various suppliers, including Arup (services in the built environment), CambridgeHOK (glasshouse manufacturer), Philips (LED lighting) and Sterner Aquatech (water treatment equipment for aquaculture). GrowUp also had to identify and approach relevant regulatory authorities to gain accreditation as a food business. The necessary industry-specific approvals included aquaculture production and food safety approvals. Figure 3 illustrates GrowUp's key stakeholders.

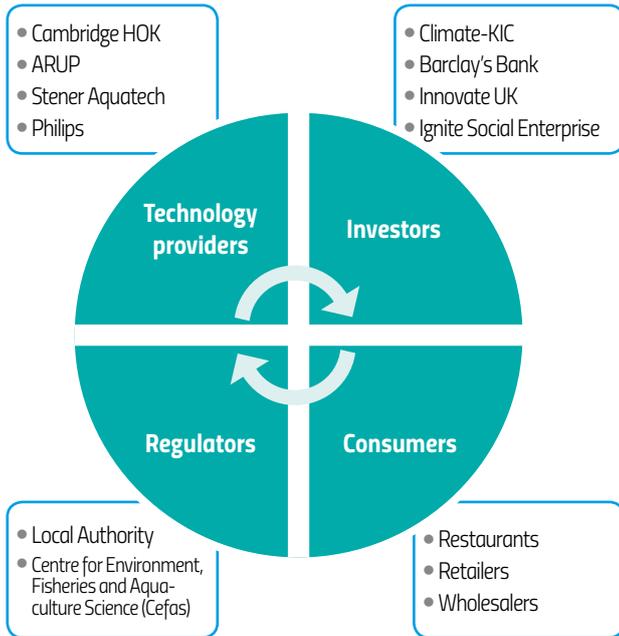
At full capacity, the 600 m² Unit 84 farm can produce 20,000 kg of leafy salads and herbs as well as 4,000 kg of fish every year. In aquaculture systems, water circulates through several filters (including drum, bio and ultra-violet). When required, water passes from the aquaculture system to the hydroponic system, where the plants are stacked in ten levels and the environment is controlled to maximise their growth. This allows the company to grow salads with more than ten times the yield per square metre compared with field-grown crops, with the year-round growing cycle being between 7 and 31 days. The fish and plants farmed in Unit 84 are well suited to

Figure 2. GrowUp Urban Farms: organisational history



Source: GrowUp Urban Farms

Figure 3. GrowUp's key stakeholders



Source: GrowUp Urban Farms

this aquaponics model. Tilapia fish are omnivores and live in large groups in warm water, which means they can be farmed at high density and during the summer months. The herb and salad varieties are selected because they are adapted to nitrogen-rich water.

According to internal estimates, Unit 84's closed-loop production system creates 0.58 kg CO₂ emissions per kg of greens grown, while conventional UK greenhouses create 1.4–4.7 kg CO₂. In addition, GrowUp produces significantly less greenhouse gas emissions associated with the distribution of food. Due to reduced physical distances between food production and consumption, GrowUp can realise carbon emission reductions from transport (it makes deliveries using an electric van³) and refrigeration compared with imported food. Furthermore, growing food close to consumers enables the company to deliver products within 12 hours of harvest, which reduces the likelihood of food spoilage and waste. This is especially important, since postharvest handling and storage together with distribution account for about 30 per cent of the total carbon footprint of conventional food supply chains.⁴

Once operating at full capacity, GrowUp's monthly turnover will be more than £55,000 with a gross profit margin of 25 per cent. The main revenue streams are generated from selling the farm's produce, with additional revenue coming from group farm tours and consultancy services for clients and citizens interested in the role of aquaponics in sustainable agriculture.

Overcoming challenges through building relationships

The main technical challenge for GrowUp was to match the technology with the space in an existing warehouse that had not been designed for food production. Exchange among technology providers was required to make collaborators from different fields comfortable with designing and working under new conditions, including space constraints. When designing an urban aquaponic farm, it is important to consider non-farming activities, including food preparation, packaging, storage and office space. GrowUp had to undertake further capital investment to meet a third-party accreditation requirement to resolve regulatory food preparation and packaging requirements. Operational efficiency considerations also had a large influence on the design of the facility. Maintaining optimal growing conditions, including lighting, temperature and humidity control, is energy-intensive and costly. The integration of passive and active cooling systems as well as applying a heat exchange system between the aquaculture and hydroponic system represent just two solutions developed by GrowUp to lower its energy bill.

Accessing capital was another challenge. In an investment market that is geared towards technology start-ups with low capital expenditure, securing funding for capital-intensive ventures, such as commercial aquaponics farming, is difficult. GrowUp overcame this barrier by combining various funding options for each project stage ranging from crowdfunding to incubation funding and then seed funding, as discussed. However, as the vertical urban farming industry expands globally, the choice of suppliers of technical equipment and solutions should broaden, enabling farm designers and operators to utilise market forces in procurement to drive down capital costs.

Innovative cross-industry projects also have to strike new regulatory paths. The GrowUp team had to deal with local authorities that were unfamiliar with aquaponics farms and their regulatory treatment, particularly related to the aquaculture system and food approvals for fish. This contributed to a delay in sales of fish while conditions



were met. However, while achieving regulatory compliance requires early engagement with authorities (it took four months for GrowUp to receive the relevant approvals), it also allows time to build strong relationships with the responsible authorities, which is important for future development plans.

GrowUp's experience suggests it is important to build relationships with the right customers at the right scale. For GrowUp, this means working with customers who buy significant volumes of produce, but are not large enough to have overwhelming market power. GrowUp approached single restaurants and retailers located within ten miles of the farm through produce trials and promotions, and contacted wholesalers to integrate its products into existing supply chains. One of GrowUp's major value propositions is based on the awareness that salads are not a premium-priced product but need a good story emphasising quality and reliability. GrowUp fulfilled a need expressed by relevant customers, including restaurants, wholesalers and retailers, who had tried to source local food before but were unable to access a consistent supply.

Conclusion

GrowUp Urban Farms, the UK's first commercial urban aquaponics farm, underlines the potential inherent in the food sector to tackle climate change effectively. This process required creativity and stamina to turn technical, regulatory and commercial challenges connected to the large-scale application of aquaponics into opportunities. The case study presented in this *Insight* illustrates that circular food production models based on aquaponics are commercially viable and can be scaled up, disrupting the food sector while achieving substantial climate benefits.

The key lessons learned to date are as follows.

- The design of a commercial aquaponics farm is key, not only for regulatory compliance, but also to ascertain the farm's operational efficiency and therefore commercial viability.
- It is important to engage with regulatory authorities in advance to avoid delays in production. While in many countries markets might be ready, regulatory authorities may not.
- Although GrowUp purchases renewable energy, the integration of an on-site renewable energy generation facility would significantly reduce operational costs for future farms, increasing their resilience.

- In commercial terms, GrowUp serves as a role model for using short supply chains and physical proximity to consumers to build personal relationships with local restaurants, retailers and wholesalers.
- By organising guided tours to the farm for the public, the enterprise actively shapes market perception of its concept and products through transparency and non-technical communication.
- Accessing capital is challenging for a new business and can be addressed by diversifying and gradually scaling up funding sources, e.g. crowdfunding or start-up accelerator programmes such as those provided by Climate-KIC.

Endnotes

1. European Environment Agency (2016) *Urban Environment* (<http://www.eea.europa.eu/themes/urban/intro>).
2. One example of a company setting up aquaponics systems in the United States is Pentair, see <http://pentairaes.com/commercial-solutions/commercial-aquaponics>.
3. While electric vehicles may generate significant indirect greenhouse gas emissions, recent studies show that in the UK their carbon footprint is less than that of conventional alternatives, see Wilson, L. (2013) *Shades of Green: Electric Cars' Carbon Emissions Around the Globe*, Shrink That Footprint (<http://shrinkthatfootprint.com/electric-cars-green>).
4. FAO (2013) *Food Wastage Footprint: Impacts on Natural Resources. Summary Report*. Food and Agriculture Organization of the United Nations (<http://www.fao.org/docrep/018/i3347e/i3347e.pdf>).

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About Climate-KIC

Climate-KIC is Europe's largest public-private partnership addressing climate change through innovation. With a focus on sustainable production systems, Climate-KIC is building a new foundation for industry in Europe – developing climate-friendly and economically viable circular models of manufacturing for a zero-carbon economy. Climate-KIC is supported by the European Institute of Innovation and Technology (EIT), a body of the European Union.

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About WiseEuropa and GrowUp Urban Farms Ltd

WiseEuropa Institute is an independent think-tank based in Warsaw, specialising in European and foreign policies and economics. GrowUp Urban Farms is a London-based start-up founded in 2013 by Kate Hofman and Tom Webster.

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