

全球城市化趋势将对数十亿人的粮食供应产生巨大影响。它需要将现有的农产品生产和供应链重新思考。尽管先进的温室仍然是生产蔬菜、水果、花卉的主要方式，但由于大城市的需求不断变化，绿色科技的世界正在发生变化。越来越多的垂直农场供应的新鲜园艺产品将逐步增加，以满足不断增长的特大城市人口增长需求。垂直农场将成为未来几年城市建筑和基础设施的一部分。

Annemieke Roobeek 教授关于垂直农场的研究成果将在“中国温室 2018”期间与大家面对面分享。抓住与专家面对面交流的机会吧！“中国温室 2018”系列活动官网：[www.cghs.cn](http://www.cghs.cn)。

## Novel indoor farming concepts for feeding megacities

### Providing healthy food and fresh produce for citizens in Megacities

文 / Prof. dr. Annemieke Roobeek



### The rise of novel indoor farming concepts in cities

In this article we focus on novel indoor farming concepts for feeding megacities. By doing so, we challenge the dominant paradigm in horticulture to think in at least hybrid forms of production systems. From production in endless hectares of horizontal greenhouses often far away from the customers in cities, we would like to open the conversation on additional forms of production of fresh produce towards a variety of forms of indoor and vertical farming. We put this in the perspective of the steep rise of megacities in the world. The demand for fresh produce is increasing. Most of the world population will live in cities. Feeding the world means more and more securing access to fresh food in megacities where 5 billion people will live

### Re-thinking the dominant production paradigm in greenhouse horticulture

These are exciting times. We are reaching a tipping point in greenhouse horticulture production systems. Notwithstanding the fact that advanced greenhouses are still the dominant way of producing vegetables, fresh produce, plants and flowers, the world in Greentech is changing due to changing demand from megacities.

in 2030. Most of these megacities will be in Asia. The good news is that in the megacities in Asia a growing middle class is up and coming. They have spending power. Access to and availability of fresh and safe food becomes more important than a low price alone. Although there is still a huge demand for building horizontal greenhouses at large distance from cities where land is still cheap, today there are lots of experiments on novel farming going on worldwide. These novel forms of indoor farming, such as vertical farms, container farming and fully controlled climate rooms in buildings, may offer more sustainable solutions closer to customers in cities, with less waste, less transport and pollution, and absolute freshness. With these new concepts the distance from farm to fork will be minimal.

## Public demand

It is expected that public demand, particularly from governmental authorities and city councils of megacities will increase to safeguard the basic needs of a healthy and productive population. Local governments will look for innovative and quick to install solutions to secure access to safe fresh produce for their citizens in the coming years and decades. In the traditional long-distance greenhouse facilities the loss of often 25-35% or more of the harvested production due to inefficient transportation and inadequate infrastructure was accepted. But this practice is unsustainable and not defensible in the light of Sustainable Development Goals (SDG's) as proclaimed by the United Nations in 2015 and the high demand of fresh food by millions of citizens. Moreover, it is not necessary anymore with



new growth concepts at hand. While the dominant production paradigm in horticulture of horizontal greenhouses far outside cities still leads to well filled international order books for greenhouse builders and Greentech installers, now is the time to re-think the mainstream with a future-proof perspective.

## Citizens want a healthy style of living

Everywhere in the world we see a new kind of consciousness to live a healthy life in cities. Sports, fitness, running, jogging, walking is what people do to keep in shape. However, a healthy life starts with a healthy diet. This means enough nutrition and eating fresh food full of natural anti-oxidants and vitamins. Fresh greens, salads, fruits are the first things that comes in mind. Coming from the Netherlands, there is an abundance of all kinds of fresh produce at affordable prices all over. Comparing to other countries in the world, It is an exception, because in many places there is scarcity. Most times fresh produce in cities is expensive and hardly available for daily consumption. Putting the demand for fresh produce in the perspective of the desire of millions of people to live a healthier life, there is room for innovation in the way production has been organized so far.



## Experimental and commercial initiatives all over the world

We did an international comparative study on Smart Cities and Vertical Farming. (see the white paper Smart Cities and Vertical Farming on: [www.meetingmoreminds.com](http://www.meetingmoreminds.com)). The overview shows that in dozens of cities in the world all kind of experimental initiatives are taking place to explore new ways of producing fresh produce within cities. These initiatives in urban farming, rooftop farming, indoor farming, climate rooms and vertical farming can be seen as an innovative search for new ways to a healthy style of living in cities. Fresh produce forms a crucial part of the complex puzzle to sustain and create an increasing population in cities with millions of inhabitants. Access to fresh food is as necessary as access to electricity, internet, water, education and work. Smart cities are often identified by technological development and in particularly in putting digitalization strategies into action. Here, Asian cities may have an important advantage. Having a tech-savvy generation in school and at work, there is a receptive environment and a strong demand. Important ingredients for scaling up vertical farming experiments. A closer look at the more advanced forms of vertical and indoor farming makes the blending of Smart Cities with Vertical Farming a logical and natural combination, particularly in China, Singapore, and selected cities in India. Although it may

look simple from the outside to produce green leaves in a container, It takes a lot of deep plant science combined with sophisticated high tech to create a successful climate controlled indoor or vertical farm. Many green technologies, such as climate systems, LED-lighting systems, water systems and growth protocols are all based on data and digitalization. Not land, but the availability of a digitised urban environment and collaboration between different suppliers is crucial for the early successes of vertical farming. Bottomline is that there are many opportunities in China and Asia to create favourable conditions for scaling up these novel, high tech indoor farming concepts in megacities.

## What does it mean for the Greentech business?


Thinking big is difficult for many small and medium sized companies. The Greentech industry has many smaller players who fulfil their role in the traditional production chain as specialized suppliers. Also most of the companies that deliver turn-key projects are medium-sized. The amount of money available for R&D and experimentation is limited for many of these companies. However, these companies are very advanced in sub-systems and more collaboration between them would increase the speed of innovation for new, integrated digitised growth systems. Developing an integrated growth system, including advanced knowledge, combined information, construction and installation processes and data on growth of plants. By constructing this kind of integrated systems, Greentech business can sell tailor made growth recipes for fresh produce for specific locations or megacities in the world. A



globalized approach where world class technology and deep inside plant knowledge is combined with local tastes and preferences is possible. It requires collaboration between Greentech companies, local growers and parties in the distribution, such as supermarket chains. It is right here where the existing Greentech business with their deep knowledge of what growers need and their long term client relations, can make a difference in comparison to the 'new kids on the block' from Silicon Valley and environmental activists turned vertical farmers. The novel production concepts are no immediate recipes for success, because it requires more than Led light and computers to grow reliable, high quality fresh produce in a stable way.

## **Solution is in hybrid forms of fresh food production for megacities**

The focus for the new growth strategies of Greentech firms is on the world's megacities.

Growing fresh produce in advanced, climate-controlled greenhouses close to megacities combined with novel forms of vertical and indoor farming inside cities will provide hybrid forms of fresh food production serving millions of people with a healthy diet. It will lead to a positive contribution in terms of quality of fresh produce, a more productive and energized populations, as well as an impulse to local employment, local trade and more sustainable logistics in mega-cities around the world. 

**Prof. dr. Annemieke Roobeek** together with her research team at MeetingMoreMinds has done extensive research into the driving forces behind the dynamics in the horticulture industry. While doing interviews, technology reviews, and analytical data research Annemieke Roobeek developed an international growth perspective for the Dutch export based on creating the collaborative advantage of Greentech companies and (local) growers in ecosystems.