Vertical farming in the Netherlands

Is the only way up!? 

Lambert van Horen – 27 June 2018
Urban and vertical farming initiatives are popping up in different ways.
Definition issues!?
Definition issues!? 

<table>
<thead>
<tr>
<th></th>
<th>Artificial light</th>
<th>Soil-less farming</th>
<th>Full climate controll</th>
<th>Vertically stacked system</th>
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<tbody>
<tr>
<td>Greenhouse farming</td>
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<td>Urban farming</td>
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<td>Rooftop farming</td>
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<td>Indoor farming</td>
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<td>Vertical farming</td>
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<td>Container farming</td>
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- **indicates definitely
- Could be
- cannot be
Urban farming, city farming, vertical farming, plant factories: what are we talking about?

- **Urban farming/city farming**: cultivating, processing, and distributing food in or around a city (animal husbandry, aquaculture, horticulture)

- **Plant factories/vertical farming**: systems for growing plants and vegetables under wholly or partially controlled conditions to allow crops to be grown throughout the year. These systems utilise artificial control of light, temperature, moisture, and carbon dioxide concentrations
The Dutch greenhouse area Westland could be viewed as a typical example of urban farming.
Trends that drive the development of vertical farming

- 365
  - Year-round demand

- Rise of modern retail

- Demand for local produce

- Private equity funds available
  - Excellent
  - Good
  - Average
  - Poor

- Food safety requirements

- Sustainability needs

- Population growth

- Urbanisation

- Demand for quality

- Limited availability of resources (like water)
Concentrations of vertical farming/plant factory projects are found in the US, north-western Europe and Japan

Source: vertical-farming.net, 2018

Total global number of vertical farming projects is estimated at 200-300. Total growing area in vertical farms is probably < 30 ha
Rabobank Research observations on plant factories/vertical farming

**Production**
- Year-round, high input-efficiency, consistent high-Quality, safe and clean (no insects, snails, soil etc), shelf-life improvement

**Marketing**
- Close to consumers, partnerships, publicity, showcase

**Economics**
- Income from vacant buildings, interesting for investors, crowd funding, local market

**Social**
- Engagement with local community, education

**Location**
- Plant factories can be located anywhere, if multi-layer farming is possible, limited space is needed
Rabobank Research observations on plant factories/vertical farming

- **Economics**
  - High initial investment cost, energy costs, competition from traditional horticulture/farming. Costprice app. 2* conventional

- **Cultivar**
  - Not all crops or cultivars are suitable for vertical farms because of the height of plants, pollination or other issues

- **Legislation**
  - Building aspects: transport movements, water system, floor load capacity, Ventilation etc.
  - Other legislation (organic or not?)

- **Social & Consumer**
  - Acceptance of high-tech food
Business opportunities in the Netherlands

<table>
<thead>
<tr>
<th>Key Partners</th>
<th>Key Activities</th>
<th>Value Propositions</th>
<th>Customer Relationships</th>
<th>Customer Segments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retailers</td>
<td>Production:</td>
<td>Clean, fresh,</td>
<td>Branding/labelling</td>
<td>Regular consumer</td>
</tr>
<tr>
<td>Investors</td>
<td>- Food</td>
<td>constant quality</td>
<td>Quality and taste</td>
<td>International</td>
</tr>
<tr>
<td>Seed suppliers</td>
<td>- Non-food</td>
<td>food</td>
<td>guarantee</td>
<td>consumer</td>
</tr>
<tr>
<td>Other vertical farmers</td>
<td>- Transplant</td>
<td>New plant variations</td>
<td></td>
<td>Fine dining</td>
</tr>
<tr>
<td></td>
<td>Selective breeding and R&amp;D</td>
<td>The highest plant based compounds</td>
<td>The cleanest medicinal material</td>
<td>Kosher</td>
</tr>
<tr>
<td>Key Resources</td>
<td>Big farming knowledge base</td>
<td>Supply chain integration</td>
<td>Close to consumption in time and place</td>
<td>Medicine/make-up producers</td>
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<tr>
<td></td>
<td>- Good education</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- Growth data</td>
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<table>
<thead>
<tr>
<th>Cost Structure</th>
<th>Revenue Streams</th>
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</thead>
<tbody>
<tr>
<td>Initial investment</td>
<td>Sales - Food</td>
</tr>
<tr>
<td>Power consumption</td>
<td>- Processed</td>
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<tr>
<td>Price of land</td>
<td>- Unprocessed</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>- Non-food</td>
</tr>
<tr>
<td>Labour</td>
<td>New crop variations</td>
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<tr>
<td>Automation</td>
<td>Growth recipes</td>
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</tbody>
</table>

= Big points of attention
= Small points of attention
There is still a big gap in both investment costs and operational costs between vertical farming and farming in a glasshouse.

*Indication of investments and operational costs of Greenhouse production and Vertical Farming, (HAS research)*

<table>
<thead>
<tr>
<th>In EUR per m²</th>
<th>Greenhouse (Dutch high-tech glasshouse)</th>
<th>Vertical farm (indoor multilayer system)</th>
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</thead>
<tbody>
<tr>
<td><strong>Investment costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Greenhouse/indoor farm</td>
<td>100</td>
<td>1000</td>
</tr>
<tr>
<td>- Automation</td>
<td>100</td>
<td>Included in farm price</td>
</tr>
<tr>
<td>- LED</td>
<td>100</td>
<td>300</td>
</tr>
<tr>
<td>- Land price</td>
<td>50-100</td>
<td>?</td>
</tr>
<tr>
<td><strong>Operational costs</strong></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>50-100</td>
<td>250</td>
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For greenhouse mainly labour, energy, depreciation, inputs etc.
For vertical farm electricity costs are high.

50-100  Ca. 250
Dutch consumers seem to be indifferent towards the system of growing; price as well as ‘safe and clean’ product are more important.

What is most important to consumers when they buy bagged lettuce?

- Zero contaminants: 30.0
- 3 days longer shelf-life: 25.0
- Information about nutrients: 10.0
- Produced in Netherlands: 15.0
- Lowest price: 30.0
- Other: 5.0

Dutch consumers seem to be indifferent towards the system of growing; price as well as ‘safe and clean’ product are more important

For what characteristics are consumers willing to pay extra when they buy bagged lettuce?

- Zero contaminants
- 3 Days longer shelf-life
- Production as controlled as possible
- Production as natural as possible
- Knowledge about nutrients
- Produced within 10 kilometers
- Produced in the Netherlands
- Quality always constant

Outlook for vertical farming (1)

- Plant factories are not the solution for feeding the increasing global population because production costs are too high for growing staple foods.

- Large scale production of crops that compete with crops grown in traditional systems (open field, greenhouses) is not (economically) viable in the coming years.

- Economics are a major obstacle for further rollout of vertical farming;

- Strong decrease in electricity prices will have a major impact on vertical farming business models.
Outlook for vertical farming (2)

• Various business models are already viable or will be in the coming years
  • R&D, breeding (algorithms, technological solutions)
  • Propagation of young plants, seedlings
  • Local initiatives with customers that are willing to pay high prices
  • Large players with efficient production that are able to produce high value products such as herbs, niche vegetables, or lettuce
• Vertical farming can provide interesting opportunities for concepts that integrate farming and foodservice or integrate farming and retail.
• Research and production of plants for medicinal or pharmaceutical purposes
• Production of high value products at specific locations: isolated islands, deserts, extremely cold places etc.
Current greenhouse
Future?
Thanks for your attention

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