Too slow motion of new scientific results demands more efforts to define food qualities with novel methodologies.
Humans need food

- already ancient hunters did know good food qualities

- Without agriculture 250 mio humans can survive on earth.

- Agriculture was invented 10,000 years ago (together with settled life: both are success stories)
Chemical knowledge has made food production powerful

- 1840: Liebig developed the understanding of plant and animal nutrition

- 1893: Gosio discovered antibiotica (30 years before Fleming, but he wrote in Italian and was ignored)

- 1910: Haber and Bosch invented the N-synthesis

- 1953: Watson and Crick discovered the structure of DNA
7 billion people could have enough food

- affordable, enough and healthy -
> 1 billion are hungry
1,2 billion people are too fat
Every ha farm land gets 2.5 kg of pesticides a year
250 to 600 kg mineral N-fertilizers are applied per ha and year
The most important trade partners of the EU
GM crops are cultivated on 170 mio ha
Climate will change
Agricultural Biodiversity endangered
Water contamination through pesticides and fertilizer
The future agricultural challenges:

- Food security and safety
- End of fossil energy
- Climate change
- Endangered biodiversity
- Pollution (soil, water)
- Income
- Changing ethics

Recently we use our world 1.5-times
Biosphere II failed
Our beautiful little earth - facts

<table>
<thead>
<tr>
<th>Earth</th>
<th>unit</th>
<th>result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total area (Land, water)</td>
<td>Billion ha</td>
<td>51</td>
</tr>
<tr>
<td>Land</td>
<td>Billion ha</td>
<td>15</td>
</tr>
<tr>
<td>Utilisable land</td>
<td>Billion ha</td>
<td>11</td>
</tr>
<tr>
<td>Population today</td>
<td>Billion persons</td>
<td>7.2</td>
</tr>
<tr>
<td>Utilisable land per capita</td>
<td>ha / capita</td>
<td>1.5</td>
</tr>
<tr>
<td>Population tomorrow (2050)</td>
<td>Billion persons</td>
<td>9.0</td>
</tr>
<tr>
<td>Utilisable land tomorrow per capita</td>
<td>ha / capita</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Ecological footprints of selected countries and regions

- Recent Ecological Footprint
- Carrying capacity

Countries and regions compared:
- World
- HIC
- LIC
- Burkina Faso
- Egypt
- Asia
- China
- Russia
- Europe
- Switzerland
- Germany
- Latin America
- Argentina
- Mexico
- North America
- USA
- Canada

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Warsaw, Poland
German Ecological Footprint

<table>
<thead>
<tr>
<th>Categories</th>
<th>today real</th>
</tr>
</thead>
<tbody>
<tr>
<td>Living (everything related for housing: building material, heating energy)</td>
<td>1,2 ha</td>
</tr>
<tr>
<td>(27%)</td>
<td></td>
</tr>
<tr>
<td>Food (everything related to food, processing and consumption)</td>
<td>0,8 ha</td>
</tr>
<tr>
<td>(18 %)</td>
<td></td>
</tr>
<tr>
<td>Mobility: all vehicles (production and utilisation) incl. traffic infrastructure</td>
<td>0,6 ha</td>
</tr>
<tr>
<td>(13 %)</td>
<td></td>
</tr>
<tr>
<td>Commodities (all, what is used and not included in the previous goods)</td>
<td>1,1 ha</td>
</tr>
<tr>
<td>(24 %)</td>
<td></td>
</tr>
<tr>
<td>Gray area (public buildings and commodities without traffic infrastructure</td>
<td>0,8 ha</td>
</tr>
<tr>
<td>(18 %)</td>
<td></td>
</tr>
<tr>
<td>Ecological Footprint Germany</td>
<td>4,5 ha</td>
</tr>
<tr>
<td>(100 %)</td>
<td></td>
</tr>
</tbody>
</table>
If every Chinese ...
Options against designer and molecular food
Natural versus Artificial food?
Organic Farming as ONE solution for future sustainable food chain?

- Organic food production as process qualities
- Food qualities are not promised and only seen as result of good process qualities (natural food)
Organic pioneers have seen risks in chemical and industrialized food production

• 1924: Steiner has spoken to farmers in Poland to use a novel method of farming: biological dynamic agriculture was born.

• 1943: Lady Eve Balfour published a book about her experience in farming without chemistry (founder of soil association).

• 1950 onwards: Müller and Rusch have defined the biological organic (Bioland founded 1971) farming to release farmers from the pressure of intensive farming: soil health was the focus.

• ...
Global development of Organic sector

• More hectares,
• more farmers,
• increased market share,
• more in the head of consumers,
• globalisation
• accepted and promoted
The world of Organic Farming 2011

IFOAM, 2013

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Organic world market 2011

IFOAM, 2013

Global food trade: 4 trillion Euro
Global organic trade: 40 billion Euro (1%)
Organic food per capita, 2011

<table>
<thead>
<tr>
<th>Country</th>
<th>Per capita consumption in Euros</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switzerland</td>
<td>177</td>
</tr>
<tr>
<td>Denmark</td>
<td>162</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>134</td>
</tr>
<tr>
<td>Austria</td>
<td>127</td>
</tr>
<tr>
<td>Liechtenstein…</td>
<td>100</td>
</tr>
<tr>
<td>Sweden</td>
<td>94</td>
</tr>
<tr>
<td>Germany</td>
<td>81</td>
</tr>
<tr>
<td>United States</td>
<td>67</td>
</tr>
<tr>
<td>France</td>
<td>58</td>
</tr>
<tr>
<td>Canada (2010)</td>
<td>57</td>
</tr>
</tbody>
</table>
Organic consumers eat more healthy
Organic enters the market – slowly but continuously

Baby food: 60% organic
Marketing of organic products

100% Organic supermarkets

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Same price – same quality?
Non-Development of Organic sector

• Good and bad organic farming and processing is possible
• Promises like sustainability, animal welfare, fair production are not fulfilled always (not possible or not intended in production: sustainability benchmarks missed)
• Frauds
• Link between consumers and producers is lost
• Organic research has not answered the questions ...
The problem: Yield and quality stagnation

Yield development in variety trials in winter wheat in organic and conventional production (North Germany, Schleswig-Holstein, data: Landwirtschaftskammer - official advisory centre)

Organic versus conventional:

High input – high output systems:
• Organic has <50 % output

Medium input – medium output systems:
• Organic has 75 % output

Low input – medium output systems:
• Organic is like conventional

Low input – low output systems:
• Organic can have 125 % output.
GHG emission from conventional and organic farms (20:20) per ton of wheat and crop rotations

<table>
<thead>
<tr>
<th>Crop Type</th>
<th>GHG Emission (kg CO2 eq/Tonne)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat conv.</td>
<td>355</td>
</tr>
<tr>
<td>Wheat org.</td>
<td>496</td>
</tr>
<tr>
<td>Crop rotation conv.</td>
<td>376</td>
</tr>
<tr>
<td>Crop rotation org.</td>
<td>263</td>
</tr>
</tbody>
</table>

(Heißenhuber 2008)

Energy input (GJ / ha / y)

GHG emission (kg CO2eq / ha / y)

organic
conventional
GHG and organic matter per grain unit

![Graph showing GHG emissions and C-sequestration per grain unit for organic and conventional farming methods.](image-url)
Life efficiency of a cow and GHG emission

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![Graph showing life efficiency of a cow and GHG emission](image-url)
Stockless organic farming is difficult but trendy
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Director of the German Federal Thünen-Institute of Organic Farming

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Organic food can make people sick and kill
Organic research has tried to find answers ... 

- Pfeiffer has tried to proof the preparates of bio.-dyn. farming as introduced by Steiner.
- Balzer and Balzer-Graf: vital power of food, picture making methods
- Vogtmann (first organic chair 1982) has asked questions about organic food qualities and the need for research
- FiBL was founded 40 years ago (1973) and tried to answer the impact of organic farming on food.
- Millions of Euro have been spend to find answers about food qualities from organic products
- ...
Organic farming needs more research
Organic Farming Research Budgets in Europe in 2010

- EU15 total
- Danmark
- Austria
- Switzerland
- Germany

Mio €uro

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Organic Research in Germany  
(scientists, money, research facilities)

- University chairs: about 35 Professors and 100 permanent scientists, good research facilities with experimental stations (all together 1000 ha farm land and greenhouses), labs and infrastructure, 30 mio Euro / y, about 150 finishing students / y.
- Federal research institutes: about 50 scientists, 7 mio Euro / y, 600 ha experimental station, modern labs and infrastructure
- State research facilities: about 100 scientists, 3-4 mio Euro / y, experimental facilities
- Private research: 150 scientists, 4-10 mio Euro / y, labs and stations

= 435 scientists, 61-87 mio Euro / y, 2000 ha experimental stations
Agricultural Research

• Global:
  – Total: 40 billion Euro / y public and private, (IFPRI, 2008)
  – Organic: about 200 mio Euro (Germany: 25-30 %, Europe: 85 %): mainly public (0.5 % of total agri-research) (share of organic farm land: 0.8 %)

• Germany:
  – 3,800 mio Euro / y (BMELV, 2011)
  – Organic Germany: 61-87 mio Euro / y, (1.0-1.6 %) (Share of organic farm land: 6.7 %)
Main topics for scientific support of the organic sector

- Increase production per hectare and animal (resource efficiency): agronomy and livestock science
- Make organic farming more sustainable (environmentally friendly, animal welfare, fair in the whole chain): ecology, biology, veterinary, policy science
- Make more healthy food: reduce negative and increase positive ingredients (nutritional value): medicin, food processing science
- Make food profitable for the whole chain: economics and marketing science
- Understand consumer trends and habits: sociology and psychology
- Communication with farmers: towards good farm practice
Organic food research conclusion:

• In the last 15 years, there is a trend of professionalism in organic (food) research observable (mainly in Europe).
• The speed of development is – much – too slow.
• The resources for increasing speed in organic research is not sufficient (international and national public funds, private money).
• Organic farming research is focusing mainly on „last millenium“ questions and methodologies and does not have answers for future „next millenium“ challenges (hindered by standards and regulations, even in thinking)
• Organic research has lost the image as trend setter.
• Organic research must be brave for new competions, questions and methodologies.
Thank you