



# TOWARDS A SUSTAINABLE BIO-ECONOMY: LEARNING FROM NATURE

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# NIOO = the largest group of (basic) ecologists in the Netherlands

*Our four tasks:*

- Carry out basic and strategic ecological research in terrestrial and aquatic environments
- Enhance ecological knowledge to help solving societal issues
- Educate young scientists
- Pass on ecological knowledge to society (end users, stakeholders, general public)



NIOO-KNAW



Wageningen UR



**Collaboration in strategic and applied (agro)ecology**

**2011 Centre for Soil Ecology**



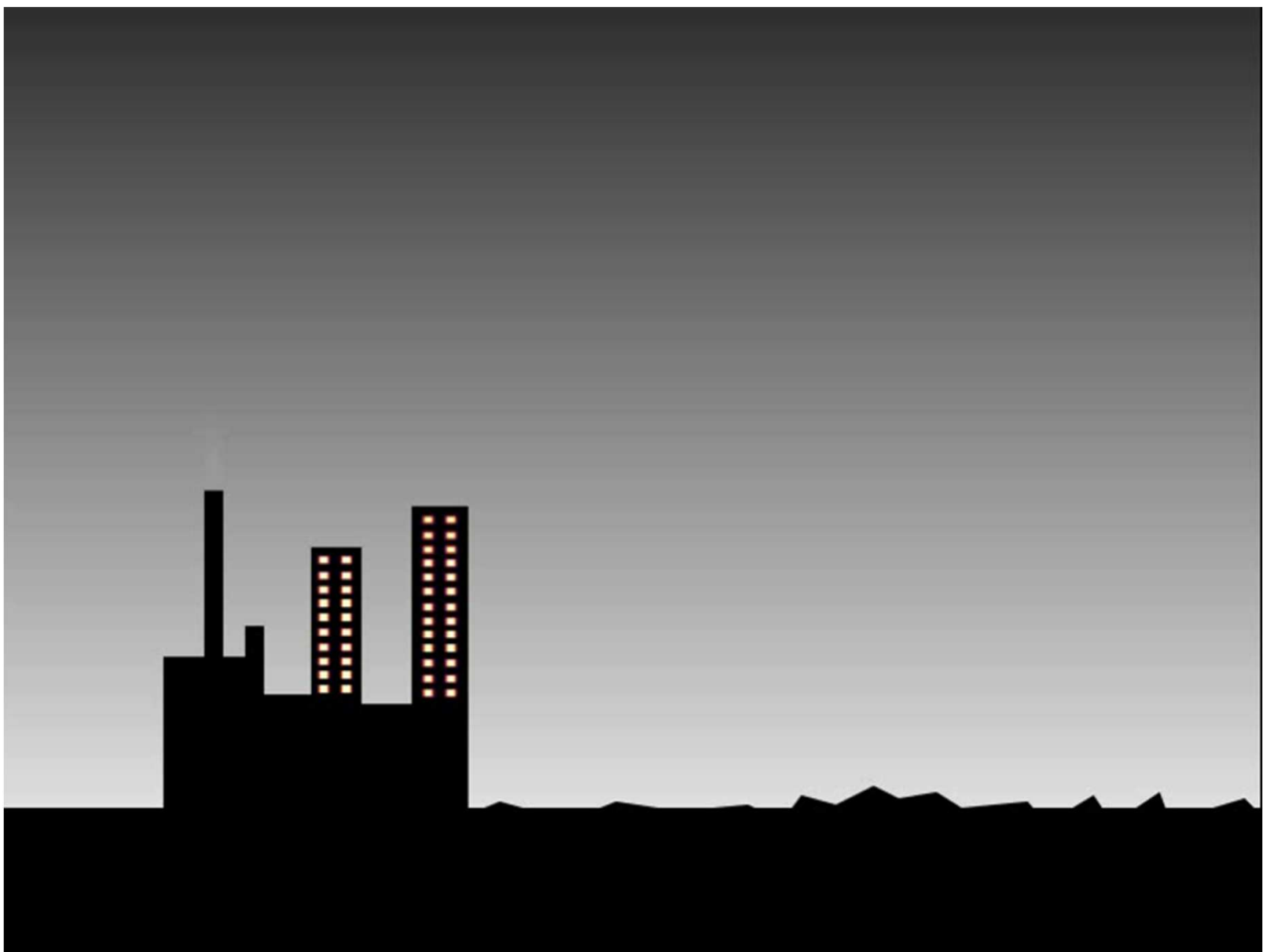
# Mission of 'Biobased Economy'

(according to Dutch Government)

Change from fossil fuels to biomass for plastics, chemicals and fuel.... **Sustainable...**



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The current linear  
take, make, waste  
economy is...







...not sustainable





EXIT



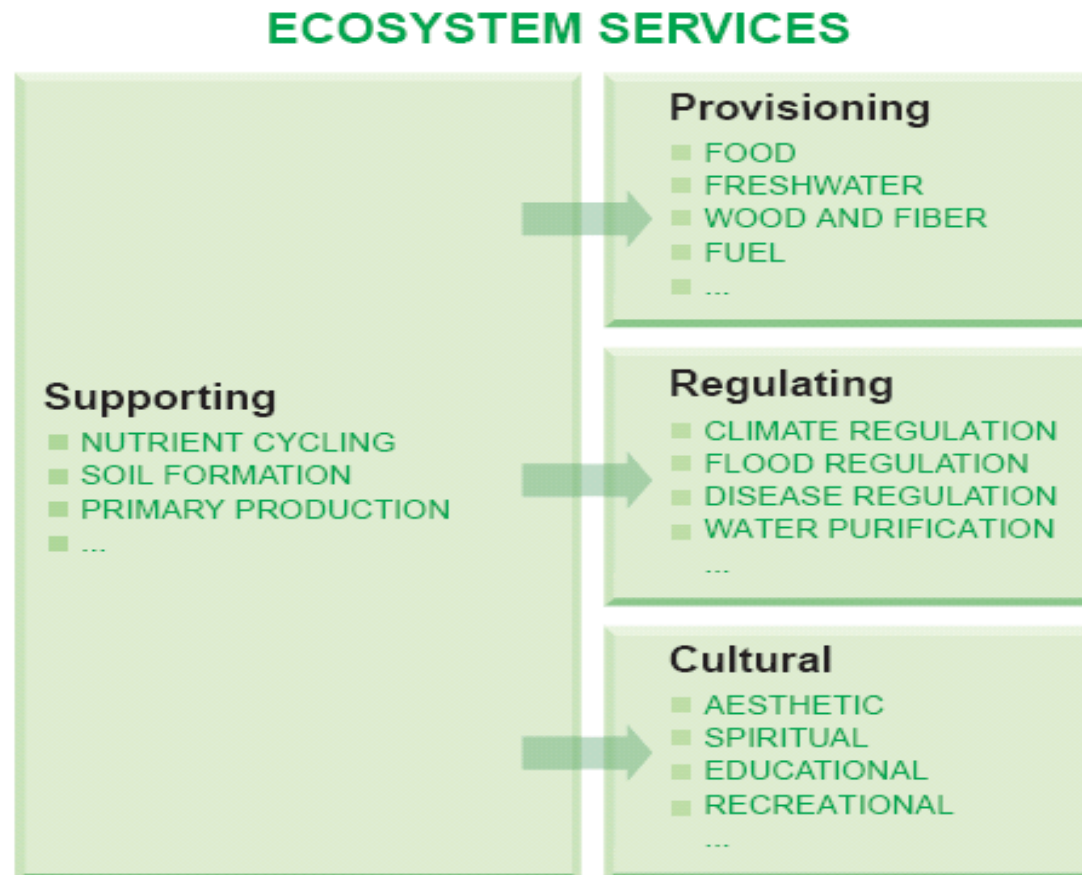
# **Destruction of our ecosystems and biodiversity**

**for food  
for energy  
for resources**



# Ecosystem Services

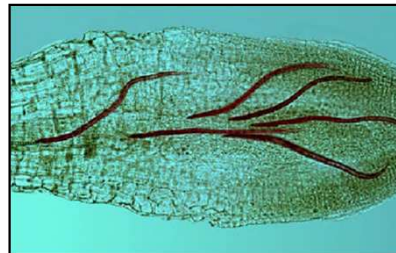
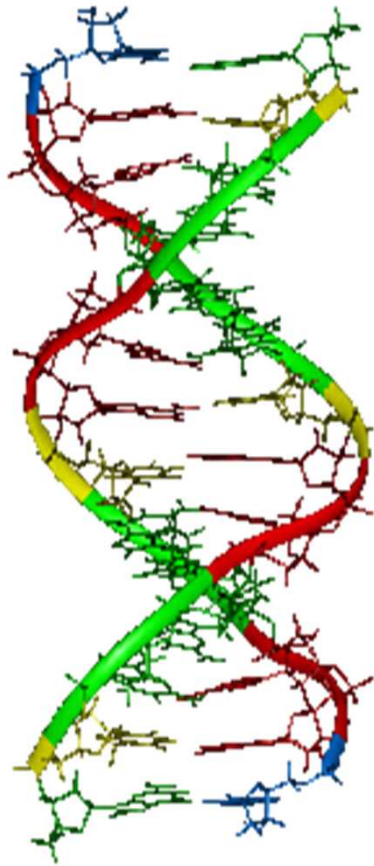
benefits people obtain from ecosystems





# Global ongoing decline in biodiversity...

(total diversity of life on earth, in form and function)



variation from gene  
to ecosystem

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*Learning from nature*  
*biodiversity*  
*has a function*



*Not one solution fits all*

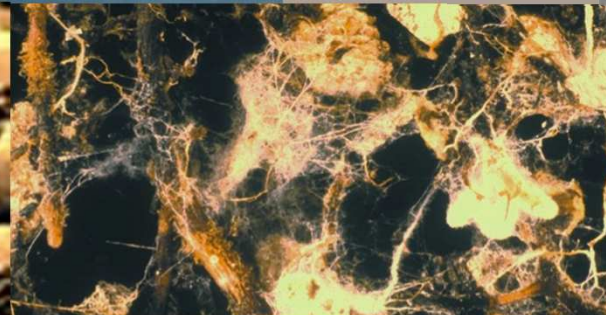
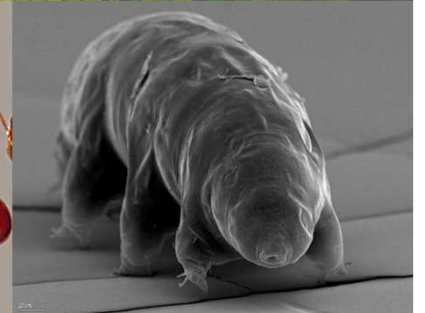
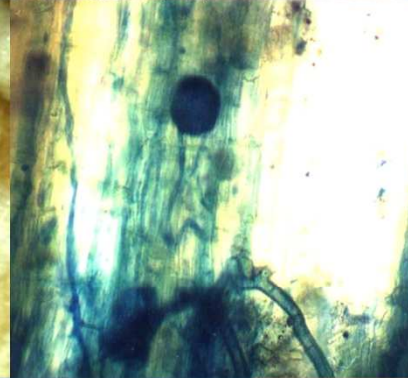


# Biological control of insect pests of banana, cocoa, and sugarcane in the Caribbean



- Complete elimination of the lizards from the islands could cause food production losses of 400-500 million dollars
- 1% drop in the lizard population would cost \$670,000 in reduced yields







# We live in a microbial world....

one gram of soil



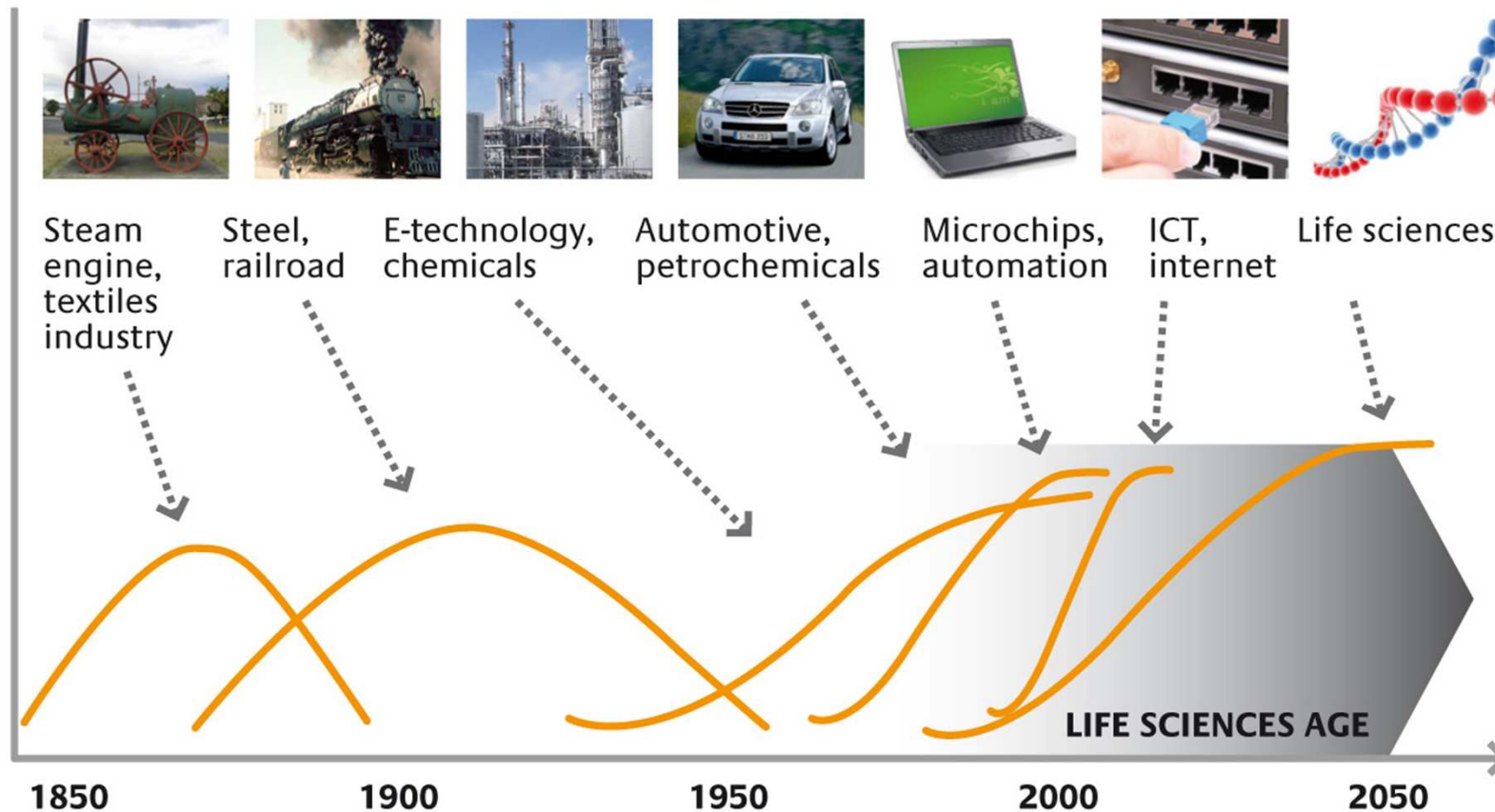
...contains as  
many bacteria...

...as humans on earth!!

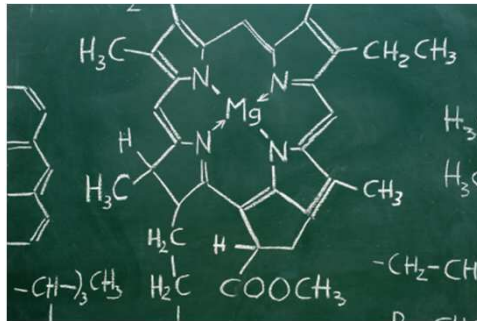


# Life Sciences

*... next big wave of entrepreneurial activity*

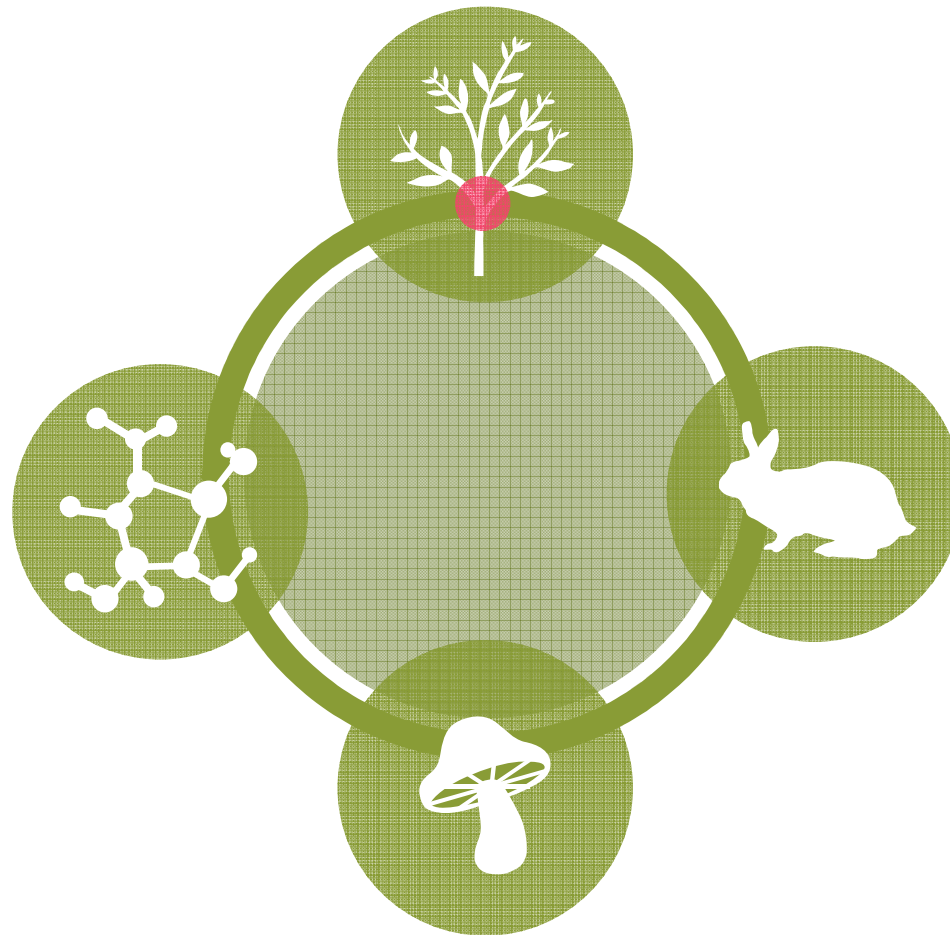


# carbon-based renewable materials





# *Learning from nature* in nature waste = food





Estimated  
opportunity for  
**USD 340-630**  
**billion** p.a. net  
material cost  
savings in EU

*McKinsey 2012*

Only 0.2% is  
used for  
coffee

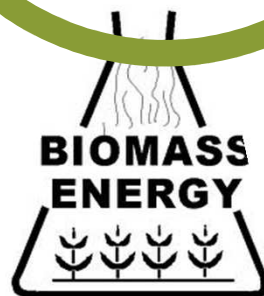
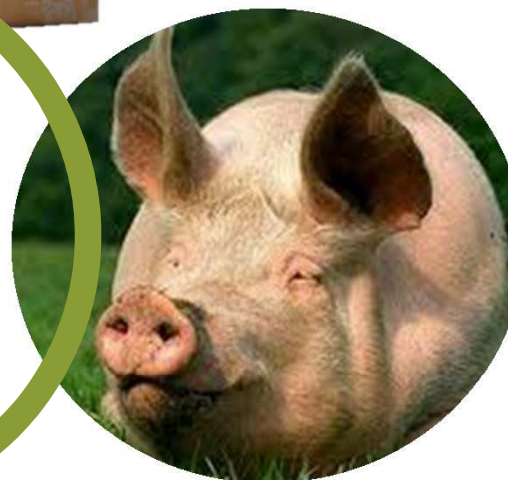
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**BE-Basic**

Biobased Ecologically Balanced Sustainable Industrial Chemistry



# Mission and ambitions



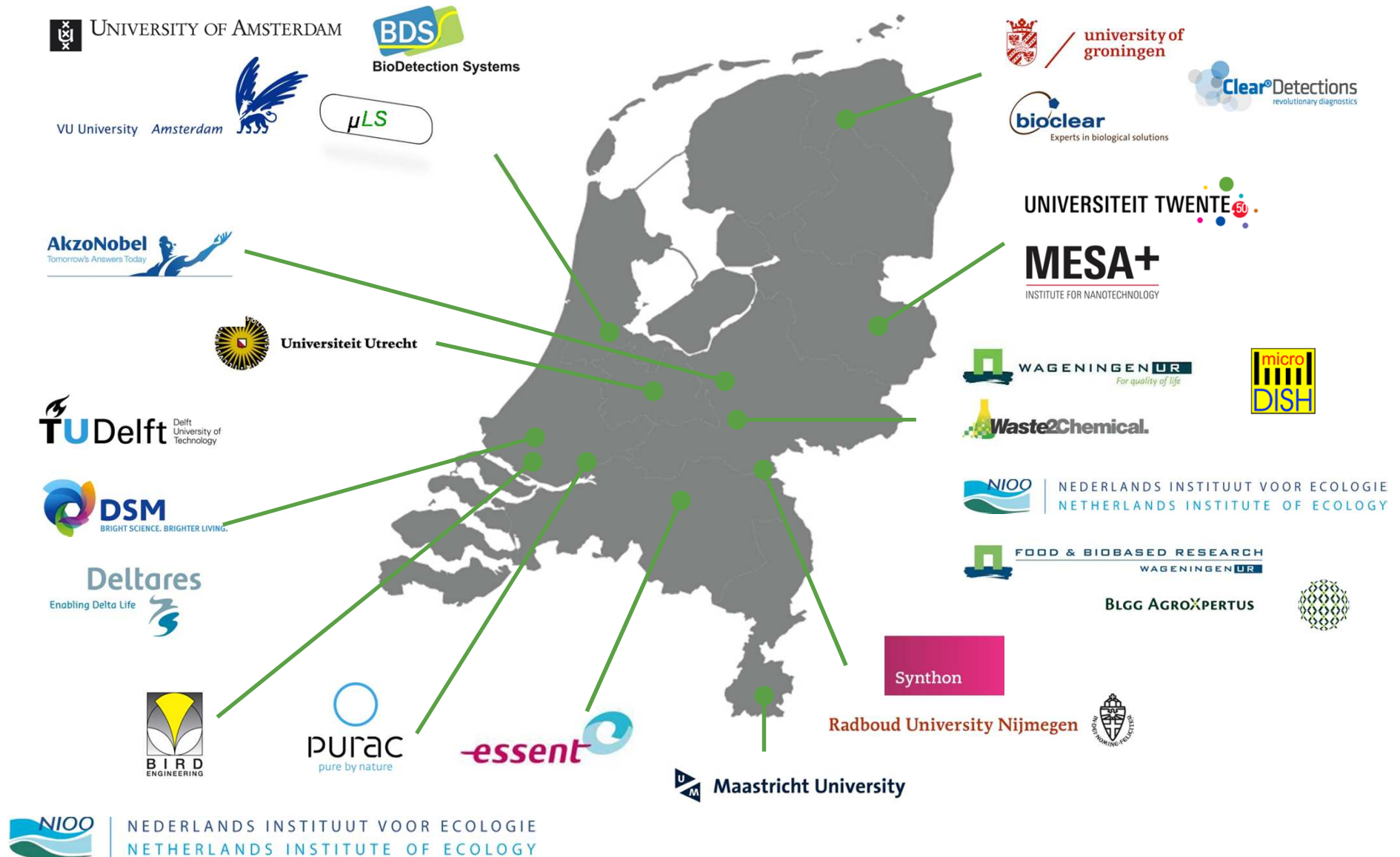
## Mission:

*“to develop **industrial** bio-based solutions for a **sustainable** society.”*

## Ambitions:

- build a competitive, secure and sustainable **bio-based economy** through industrial biotech.
- monitor ecological stresses, control and optimise complex local soil water environments through **ecogenomics** technologies
- **societal embedding** of products, services and processes

# Public-private partnership





# Partners in Brazil

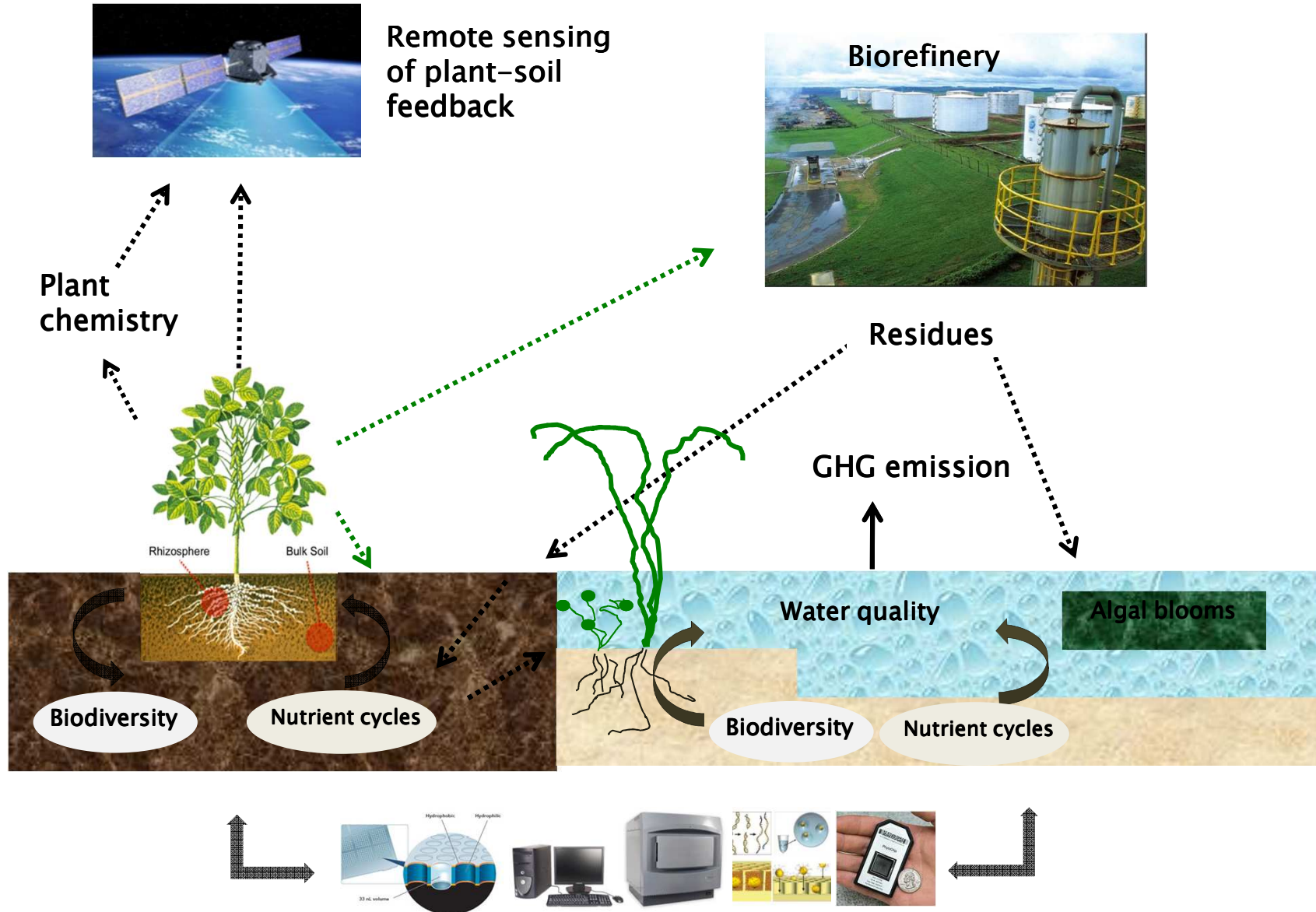


# NIOO input into BE-Basic

Development of novel methods to evaluate and improve environmental safety in the bio-based economy

**High-throughput experimentation & (meta)genomic mining:** novel high-throughput approaches to explore uncultured genomes.

# Assessing impacts of bio-based economy





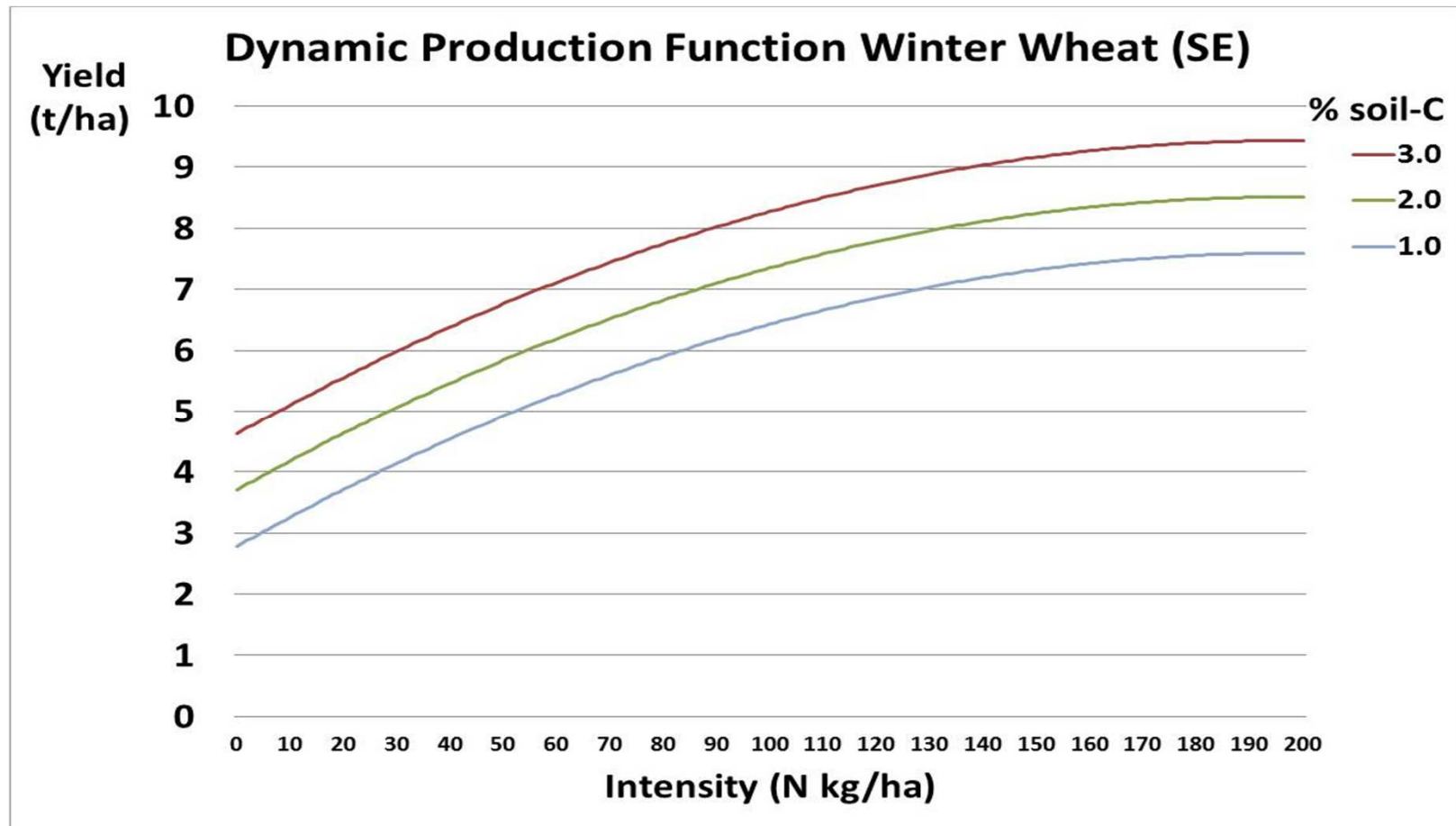
# Biobased economy: avoid soil degradation!







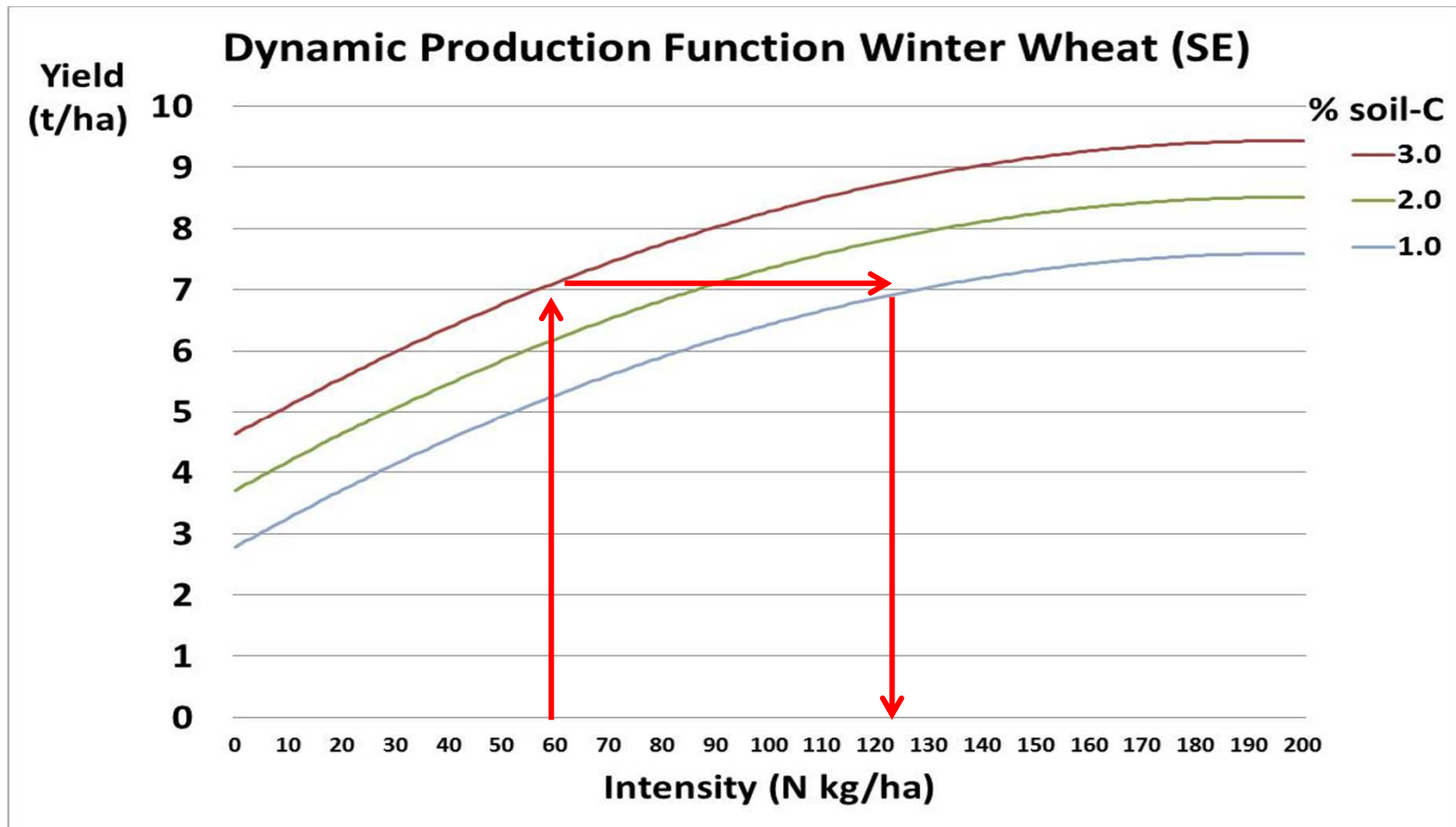
# Economic valuation - production function of a region





# Economic valuation

## - production function of a region





# Sugarcane - Brazil

## Sustainable sugarcane production:

No GHG emissions, and balanced soil organic matter levels

## Brazil: politics for environmental protection

- No burning, mechanical harvesting
- Straw added on soil
- Vinassa added into soil
- Lower input management
- Rotation: soybean (nitrogen fixation)/ sugarcane



# Joint BE-Basic/FAPESP project

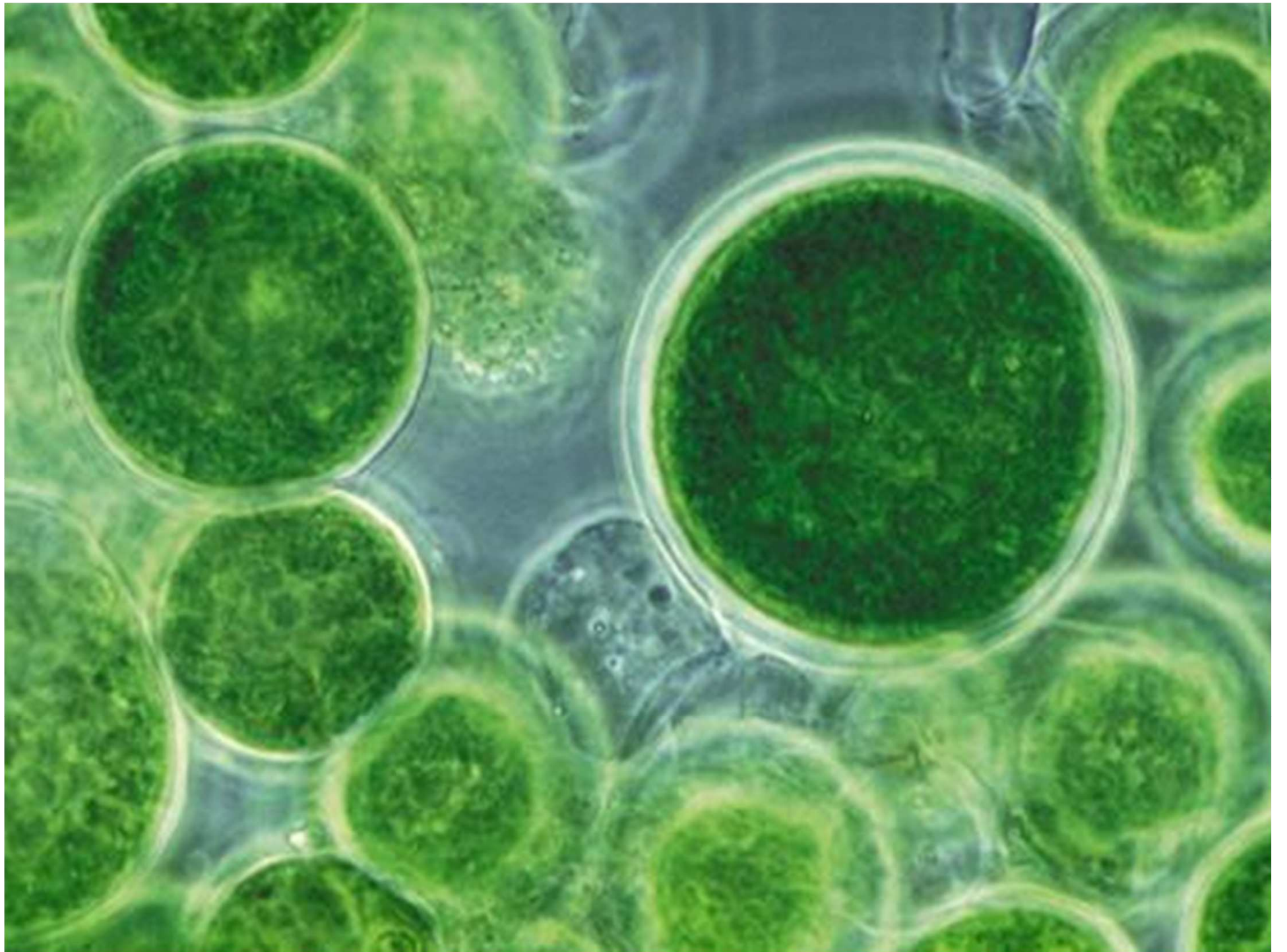
“Functional bio-indicators for soil quality monitoring for sustainable management of sugarcane biomass production (BIOSQ)”



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# AlgaePARC WUR

Algal biomass  
for food, feed,  
chemicals and  
fuels

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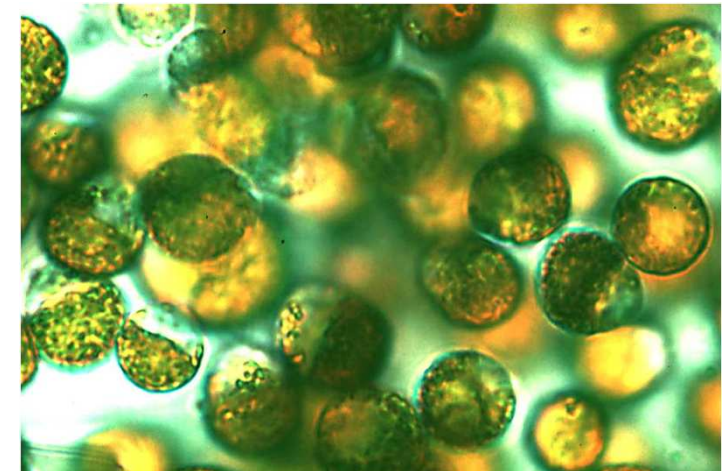
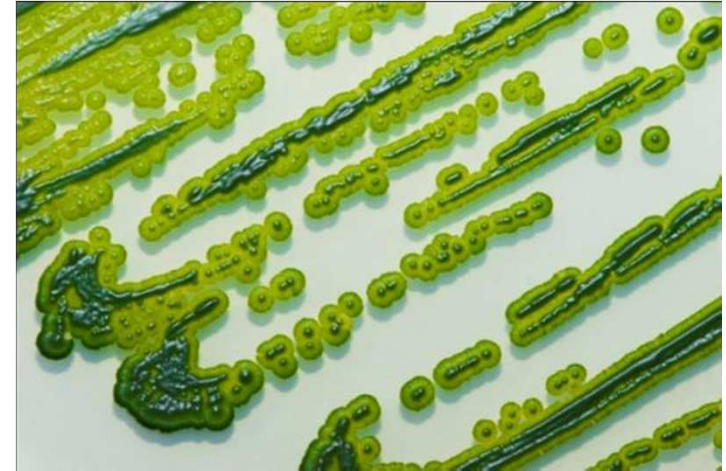


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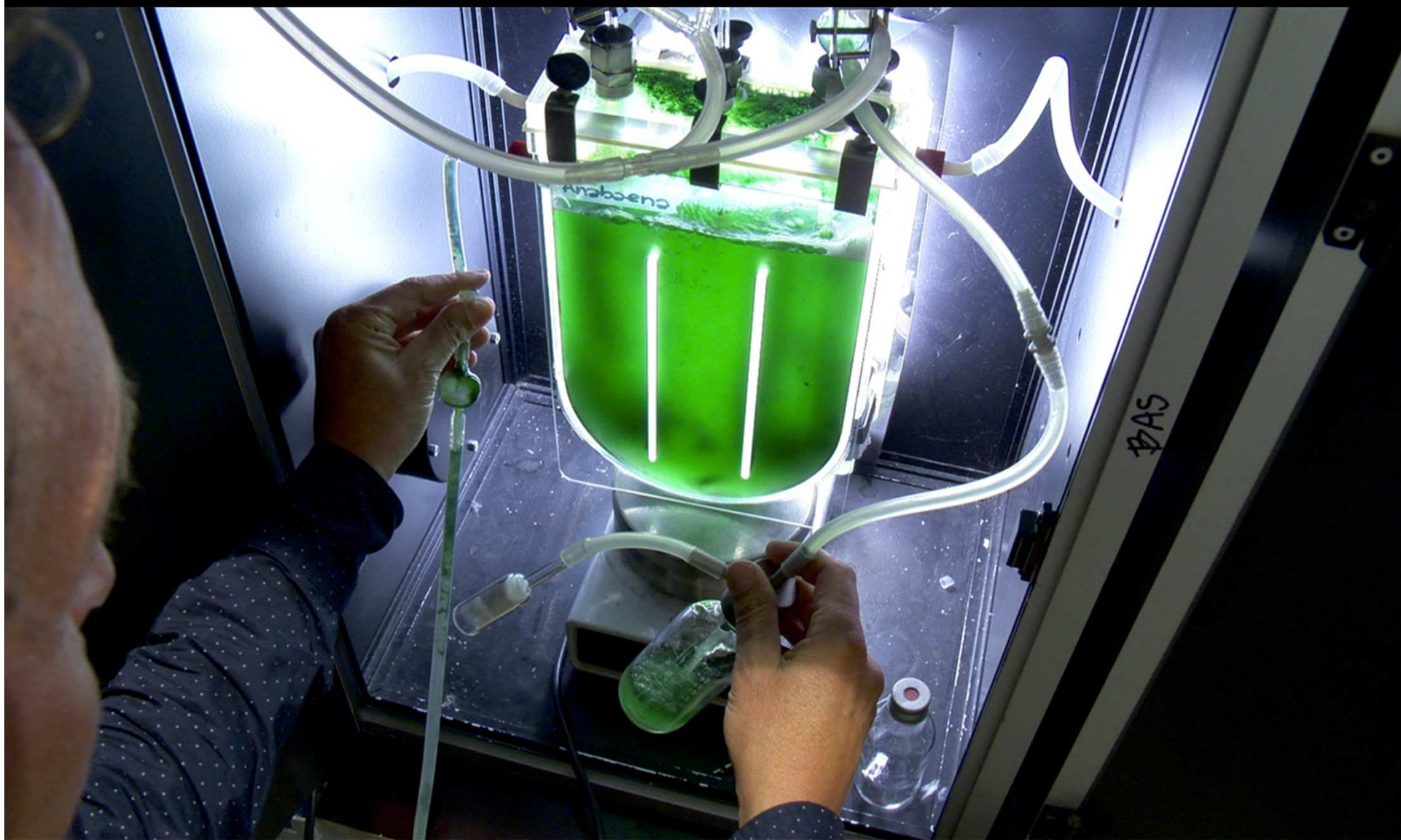


# Micro-algae as sustainable feedstock?

- ✓ High productivity
  - Oil content: 20-60%
  - 20,000-50,000 l/ha/year oil
  - Palm oil: 6,000 l/ha/year
- ✓ No 'competing claims'
  - Grow on seawater
  - Use of residual nutrients (CO<sub>2</sub>, N, P)
  - Co-products have value (e.g. lipids, proteins)











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