BE-Basic

Bio-indicators for soil quality monitoring for sustainable management of biomass production

Eiko E. Kuramae
e.kuramae@nioo.knaw.nl
NIOO | NEDERLANDS INSTITUUT VOOR ECOLOGIE
NETHERLANDS INSTITUTE OF ECOLOGY

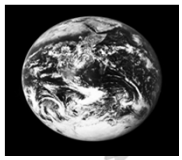
We live in a microbial world,

Intestine ± 10 X human cells

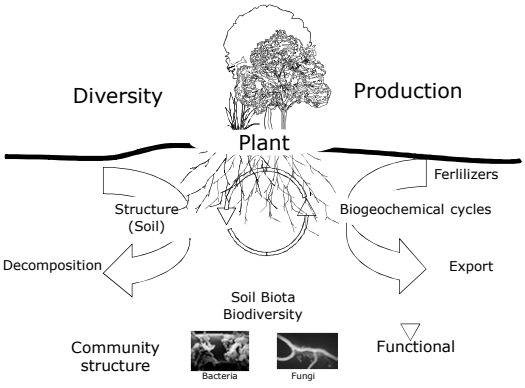
one gram of soil

…contains as many bacteria…

…as humans on earth!!



SOIL-BORNE MICROORGANISMS



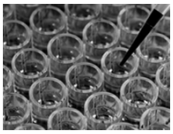
BE-Basic

Biobased **E**cologically **Ba**lanced **S**ustainable **I**ndustrial **C**hemistry

High-throughput experimentation & (meta)genomic mining

Environmental impact of chemicals, bio-based molecules and processes

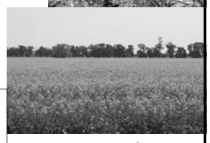
HTE and (meta) genomic mining



- Develop and apply high-throughput approaches
- Explore the metagenome (DNA directly from environmental samples)
- Engineer and screen enzymes and other products for improved properties.

Increased pressure on soil services

- Intensive agriculture
- Pollution
- Changing land usage
- Genetically modified crops
- Climate change
- Bio-based economy

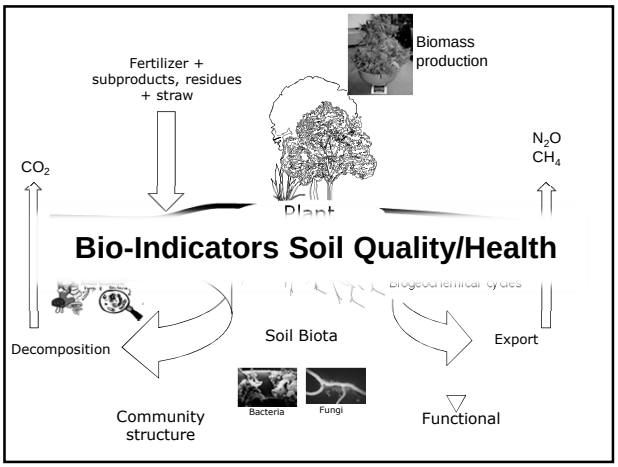


✓ Demand for sustainable agricultural development
✓ Agriculture and global change

Goal BE-Basic

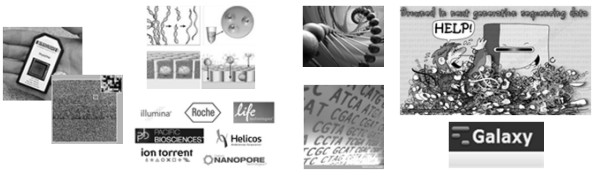
- Bio-indicators
- Develop the most predictive markers for high-throughput analyses of soil status

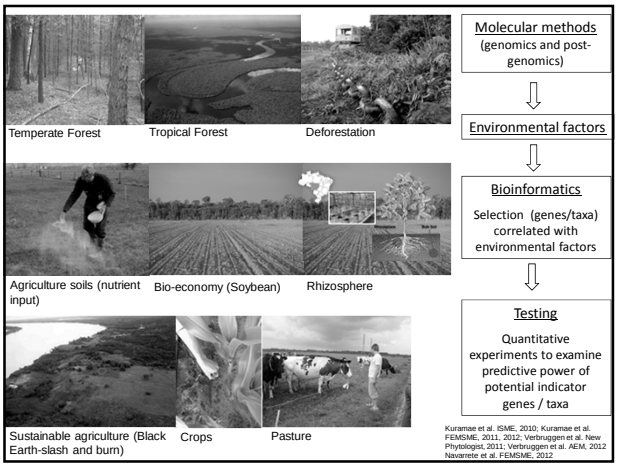
Bio-indicators are microbial species, functional genes or processes that are indicative of ecosystem changes in early stage



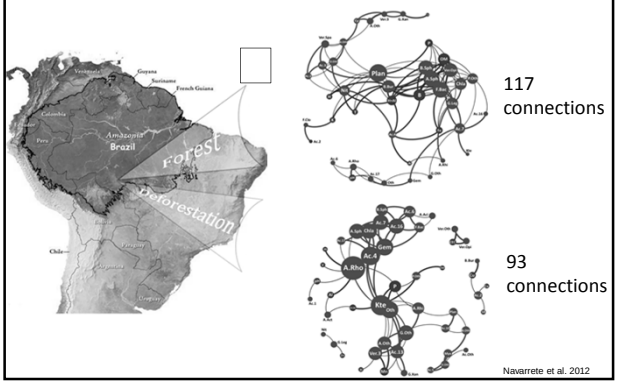
High Throughput tools for observations of soil-borne communities

- Micro-arrays (PhyloChips, GeoChips, etc.)
- New Generation Sequencing methods
- Developments in Bioinformatics





Deforestation simplifies bacterial networks in Amazon soil

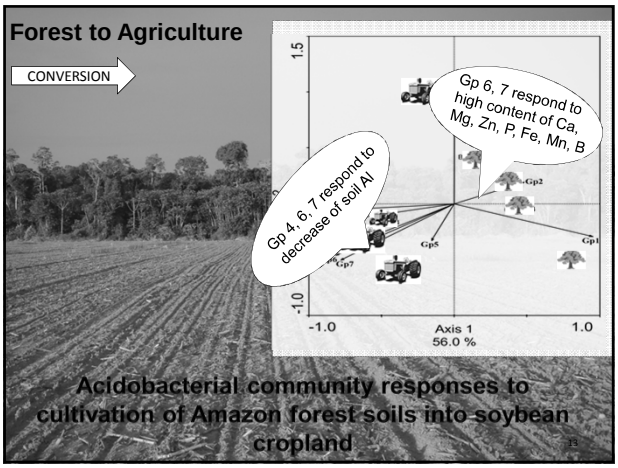


Navarrete et al. 2012

Abundance of soil bacterial groups based on pyrosequencing analysis and quantitative real-time PCR measurements in the southeastern Brazilian Amazon forest (FS) and deforested (DS) sites

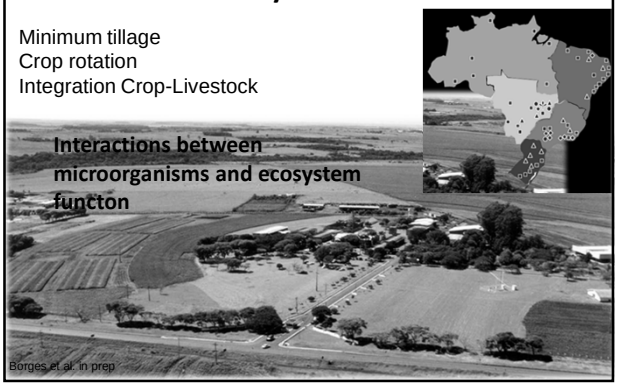
Verrucomicrobia
Decrease of 50% in deforested soils as compared to forest soils
Actinobacteria
Increase of 35% in deforested soils as compared to forest soils

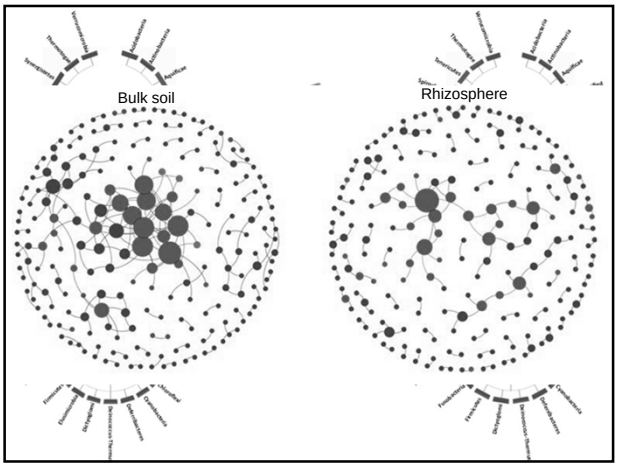
	Area 1 FS	Area 1 DS					Statistics v. DS
Relative abundance (Pyrosequencing analysis)							
Acidobacteria[1]							ns
Actinobacteria							ns
Bacteroidetes							ns
Absolute						0.0b (±2.1)	ns
Total b			(±2.1)	11.3a (±4.4)	18.0a (±2.0)	25.6b (±0.6)	ns[1]
Verrucon	(±0.01)	0.32b (±0.06)	0.61a (±0.07)	0.29b (±0.01)	0.76a (±0.01)	0.30b (±0.01)	**
Relative ab (qPCR assays) (%)							
Verrucomicrobia	3.9a (±0.42)	2.7b (±0.62)	4.6a (±0.33)	2.6b (±0.22)	4.2a (±0.5)	1.9b (±0.66)	**



Sustainable soybean cropping agriculture systems

Minimum tillage
Crop rotation
Integration Crop-Livestock





Joint BE-Basic/FAPESP project

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

- Changing agricultural practices
- Drive towards lower CO_2, CH_4, N_2O emissions and greater sustainability

Partners

Nederlands Institute of Ecology (NIOO-KNAW)
G. A. Kowalchuk
E. E. Kuramae
H. van Veen
P. Bodelier
M. De Hollander

University of São Paulo – USP
S. M. Tsai
P. C.O. Trivelin
D. G.G. Caldas

Wageningen University
H. Smidt
PhD student (vacancy)

Agronomic Institute – IAC
H. Cantarella

Biodetection Systems b.v. (BDS)
T. Janssens
B. van der Burg
M. Schmidt
R. Winter

Sao Paulo State University – UNESP
N. La Scala Jr.
J. A. M. de Souza

Bioclear b.v.
I. J. T. Dinkla
G. Faber
N. Hofman
B. Geurkink
S. Doddema
J. Krooneman

Federal University of São Carlos – UFSCar
J. Carmo

Programs

• CAPES/Wageningen:	CAPES
• Nuffic Neso Brazil:	CAPES
• Full Doctorate Abroad:	CAPES
• Global Climate Change:	FAPESP
• Biota Biodiversity Microorganism:	FAPESP
• BIOEN/BE-Basic:	FAPESP