

***How does rhizosphere
microbiome mediate
millets performance in
agroecosystems under
climate change?***



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Global Challenges

- **Stability of food production**
Despite environmental variations

- **Human population 4X**
- **Cultivated land 2 X**
- **Water use 8X**
- **Energy use 16X**

20th century

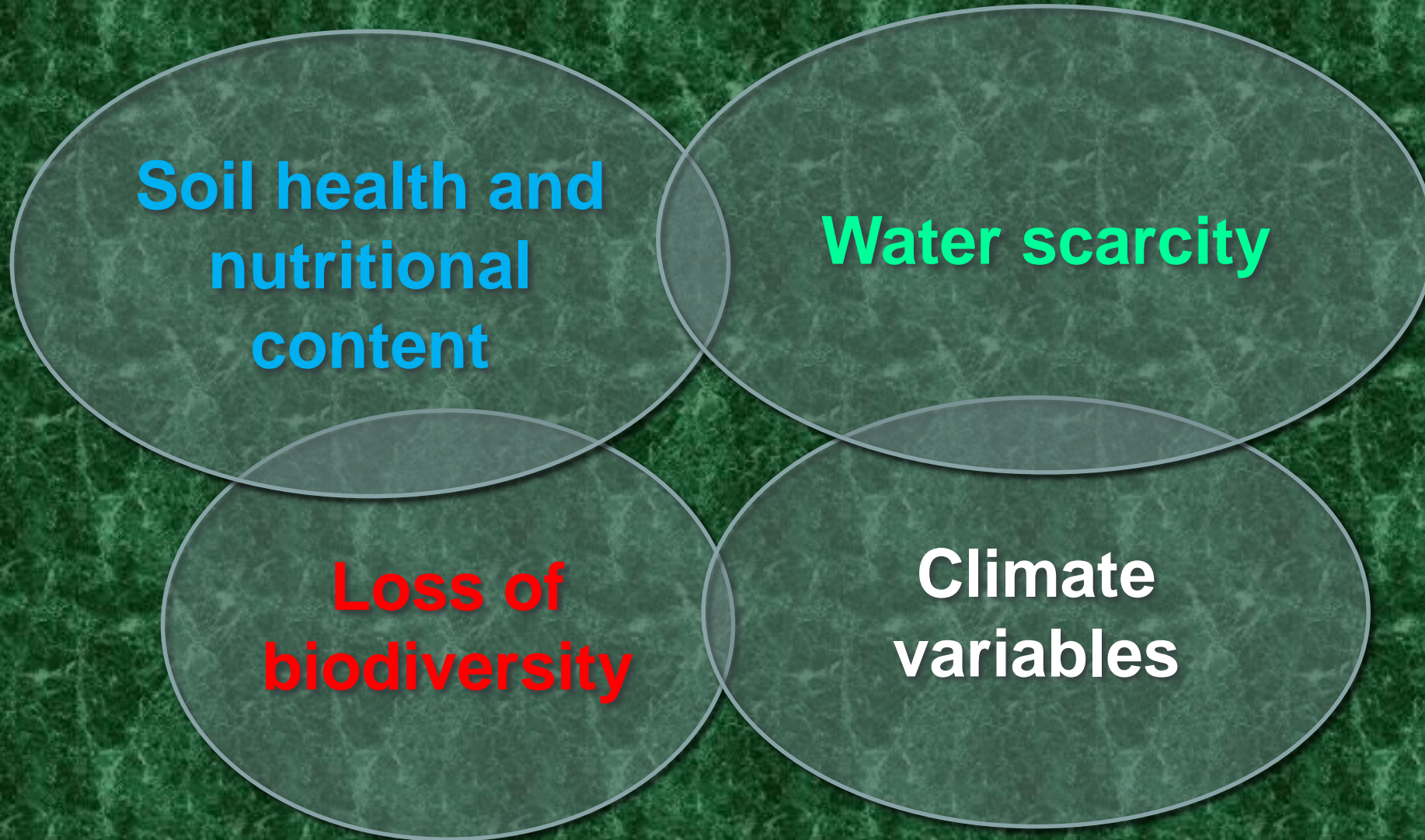
A North American study on women's shoe sizes, found that 90% of women wore size 37-38



**How to develop a
sustainable production
system for millet under
climate change....**

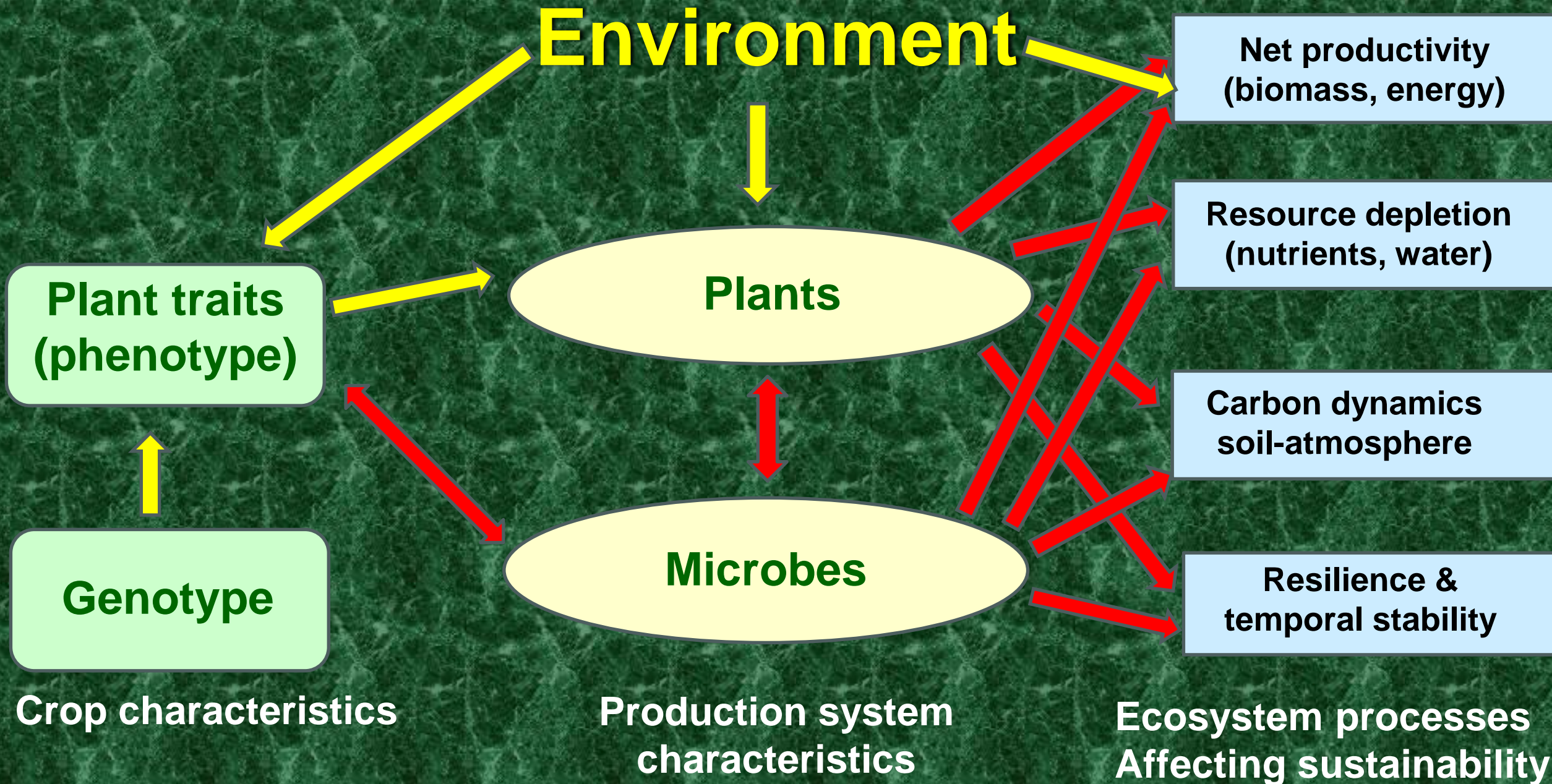


Agro-ecoystems



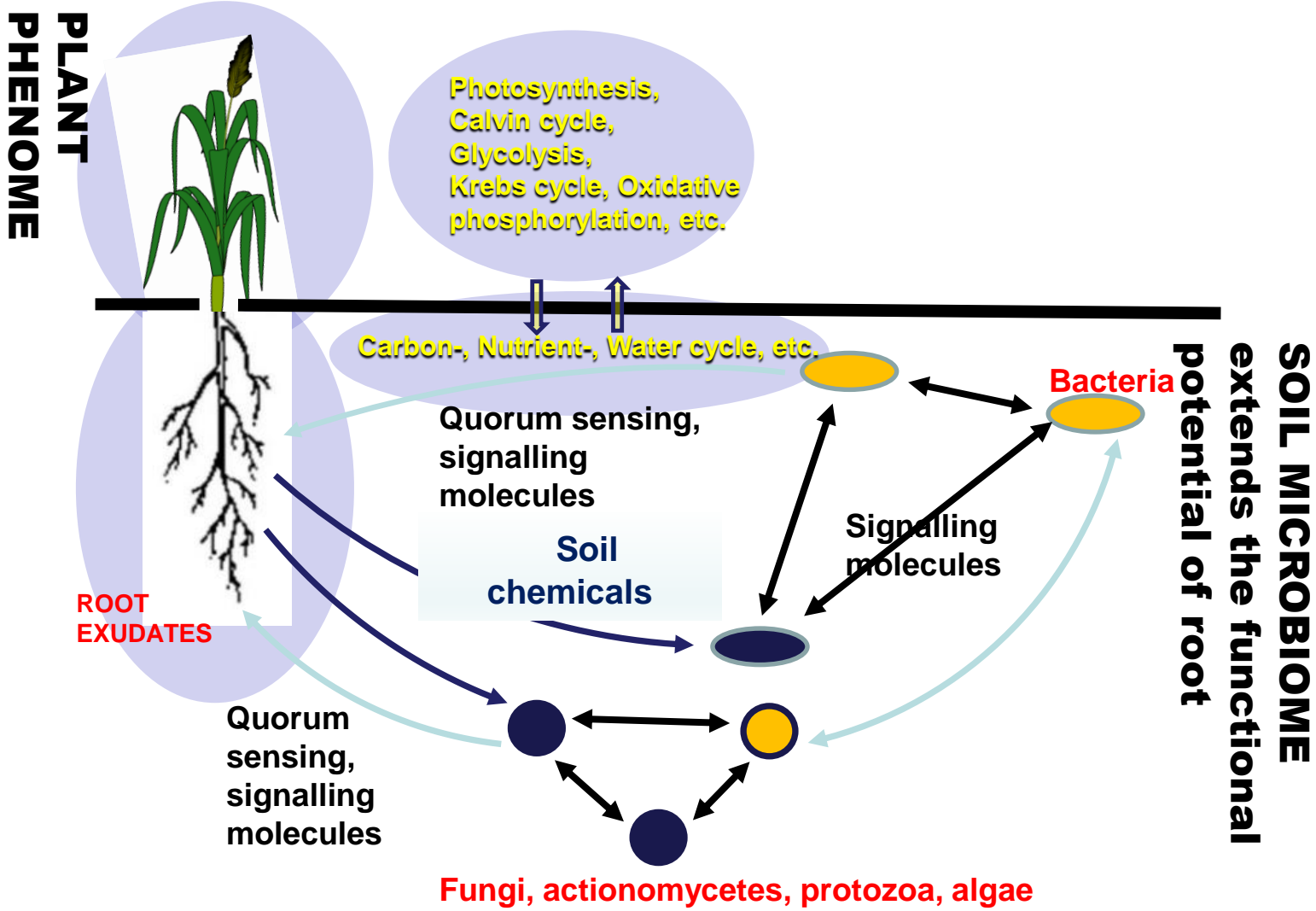
A quarter of soil worldwide faces degradation and cannot be used for agricultural production.

Land use intensification is one of the most important global changes



After Weih et al. 2014 Frontiers Energy Research

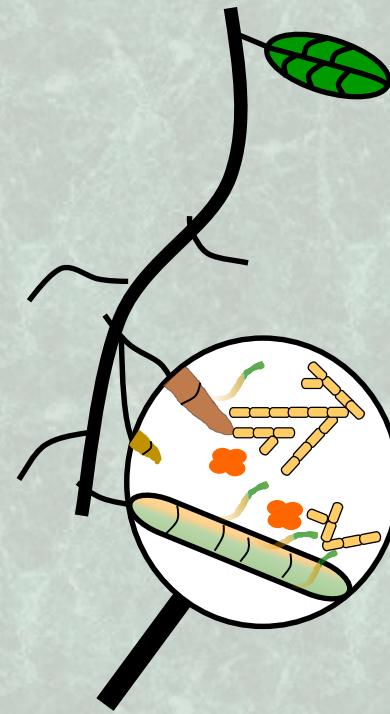
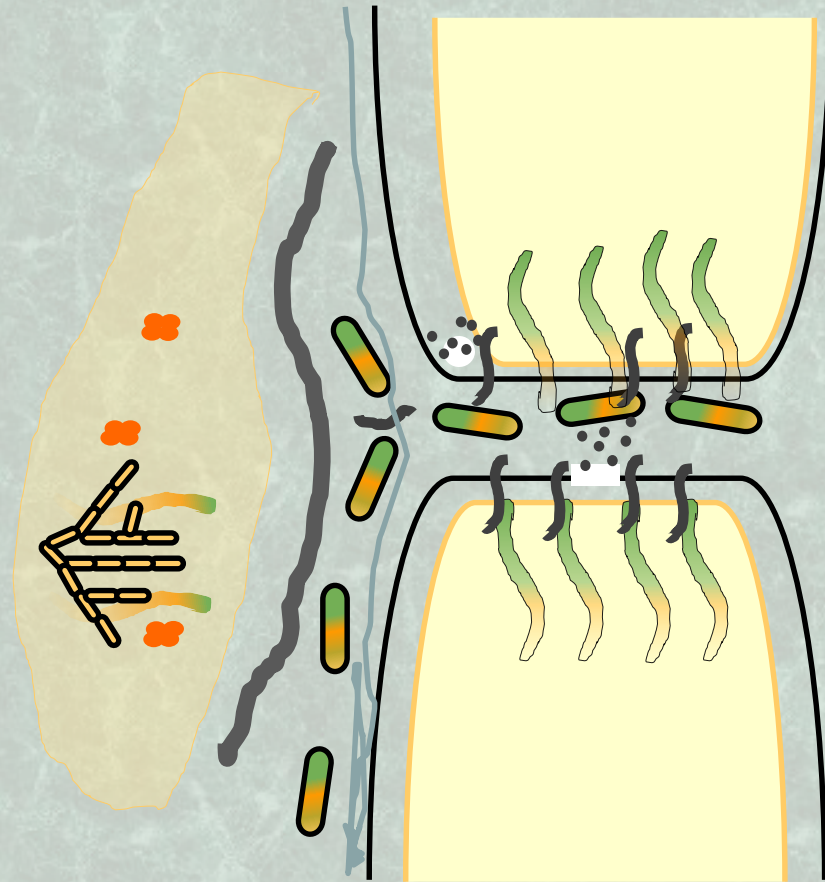
PLANT






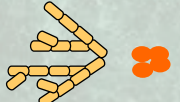


Drought tolerance enhancement by *B. thuringiensis* AZP2

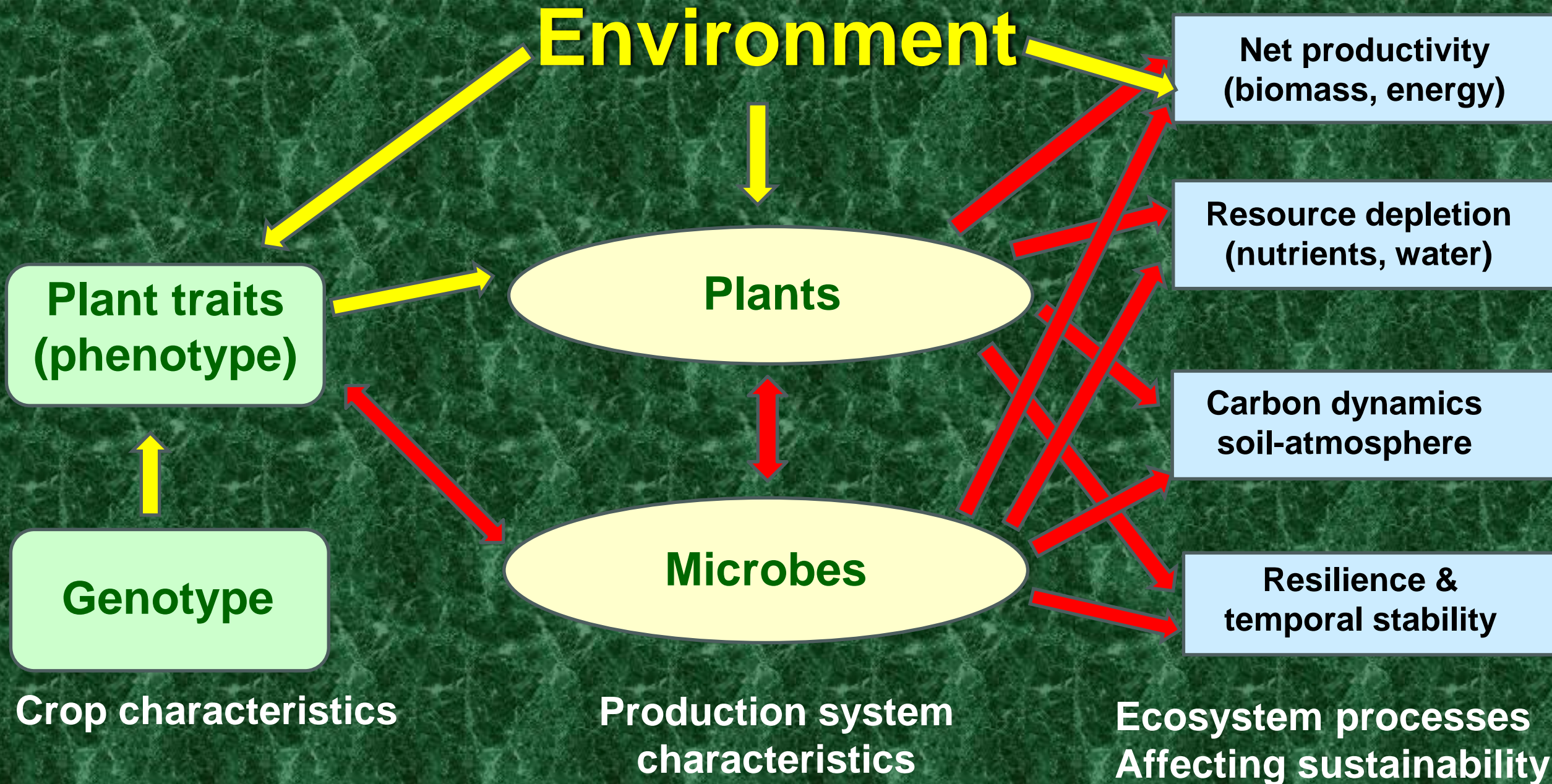


How?

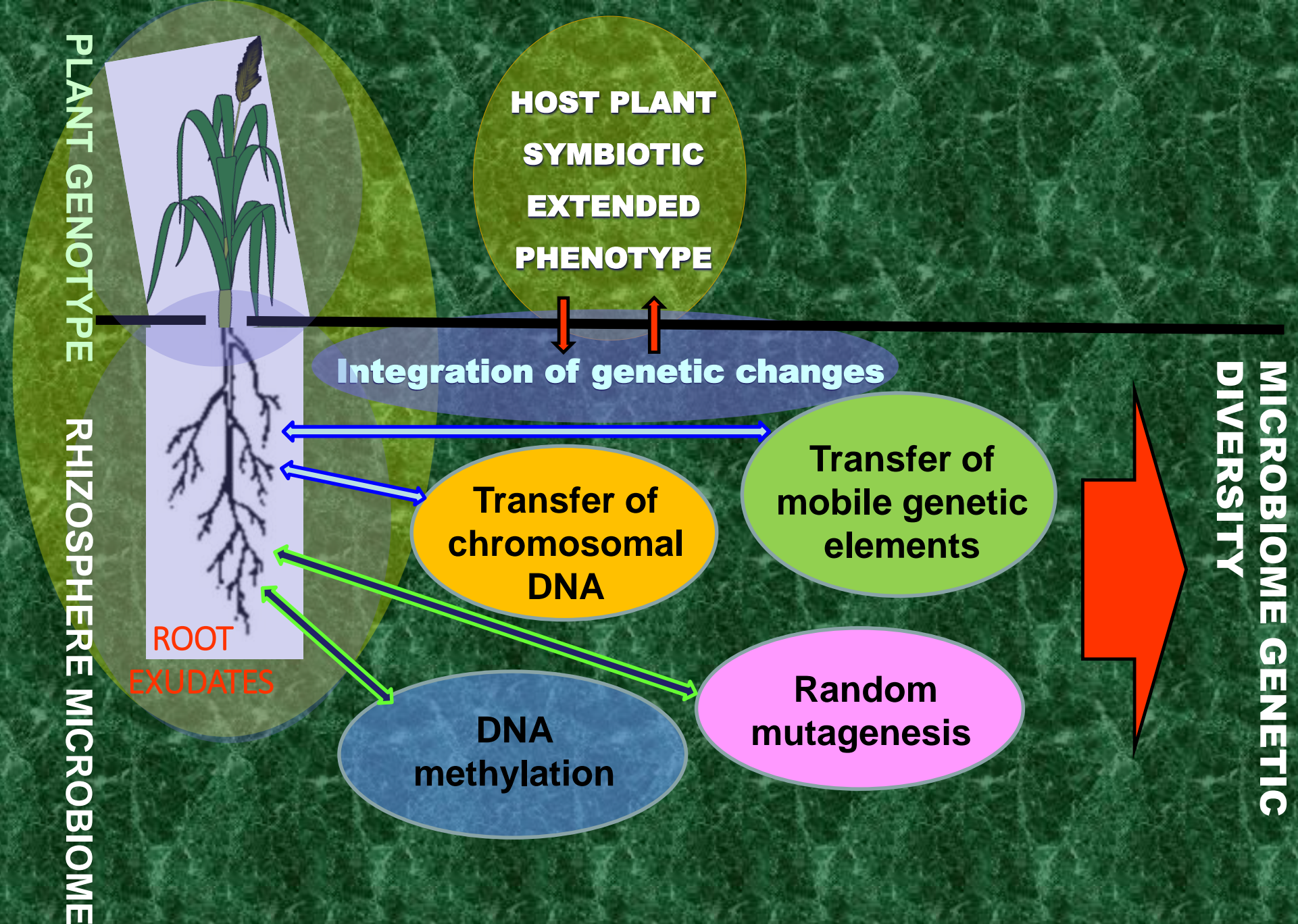


-  PGPR
-  VOC's
-  Soluble Metabolites
-  Biofilm
-  Cellular Degradation Products
-  Pathogens/Drought

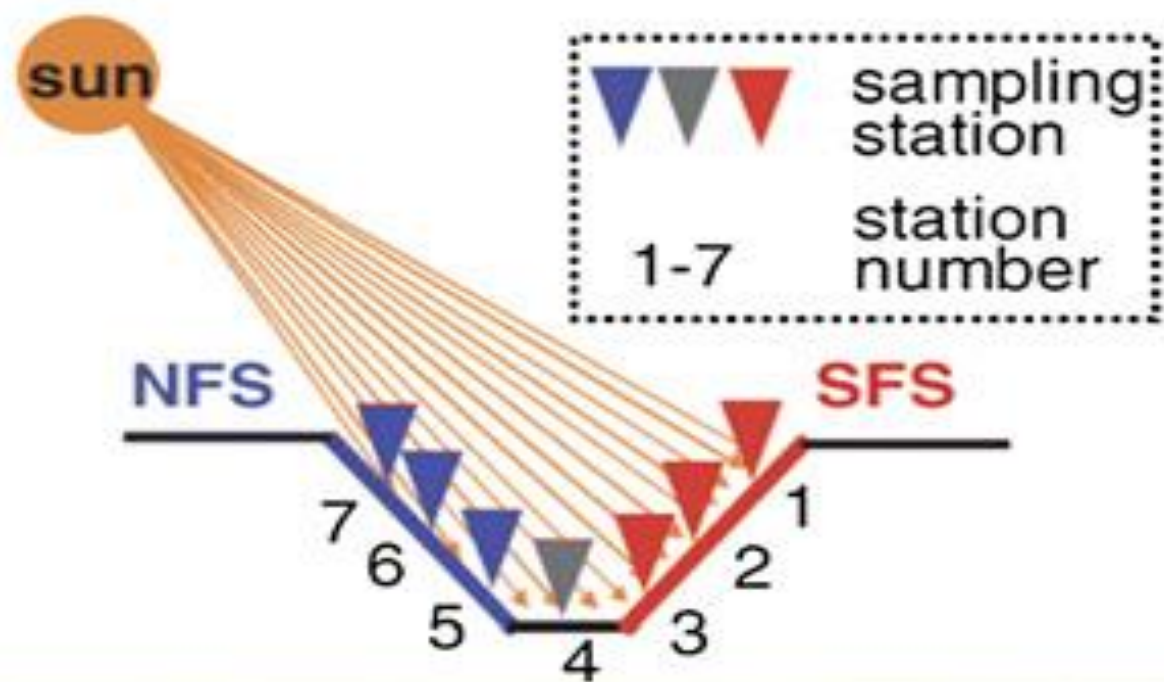
- **Novel phenotypes but the beneficial effects of microbiome applications are often not persistent under field condition**
- **We propose alternative framework reaching novel phenotypes by considering plant genome information and plant associated microbiomes together**



After Weih et al. 2014 Frontiers Energy Research



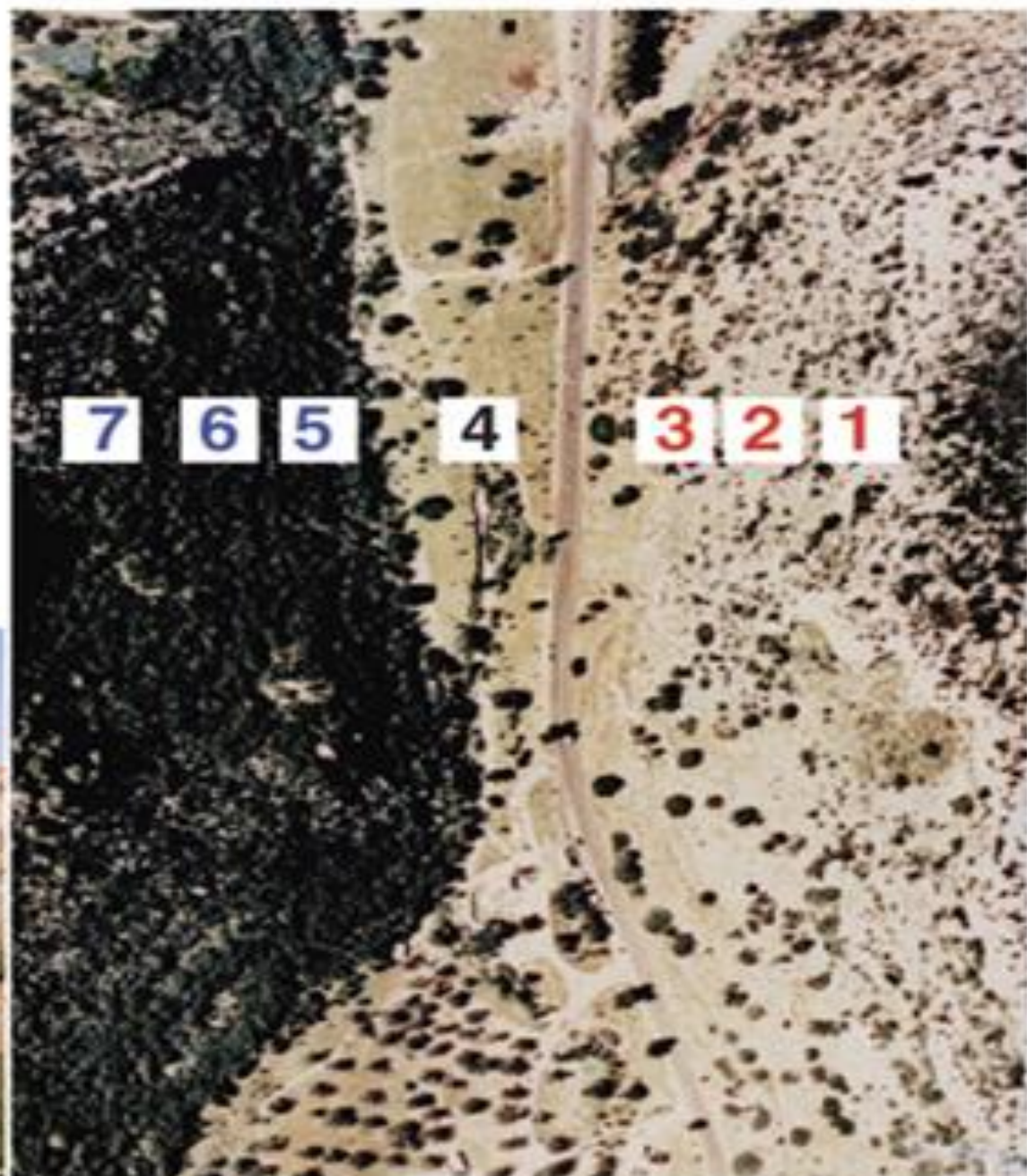
A



B



C



- **Systematic approach for identification of microbiomes ecologically and economically important for millet**
- **Identification of microbiome associated phenotypes**

- **Identify a list of crop plant candidate genomic sequences, including both genes and regulatory regions associated with stress**
- **Identify a list of crop plant candidate genomic sequences associated with stress and microbial interaction**
- **Spatial and temporal dynamics , linkages with aboveground biodiversity**
- **Spatial and temporal dynamics of land use types and intensity**

Collaboration

- **Eviatar Nevo International Graduate Centre of Evolution, National Academy of Sciences, USA**
- **Bernhard Glick Univ. of Waterloo Canada, Dept. of Biology**
- **Jonas Bergquist Uppsala Univ. Dept. of Analytical Chemistry**
- **Julian Conrad Swedish National Cryo-EM facility, SciLifeLab**
- **Ylo Niinemets, Steffen Noe Estonian Univ. Life Sci**
- **Jill Farrant, Univ. of Cape Town ZA, Dept. of Molecular and Cell Biology**
- **Diriba Muleta, Univ. of Addis Ababa, Inst. of Biotechnology**
- **Lawrence Behers Novawest Communications**

Thank you!



- **Evaluation criteria**

Plasticity:

finding the limits

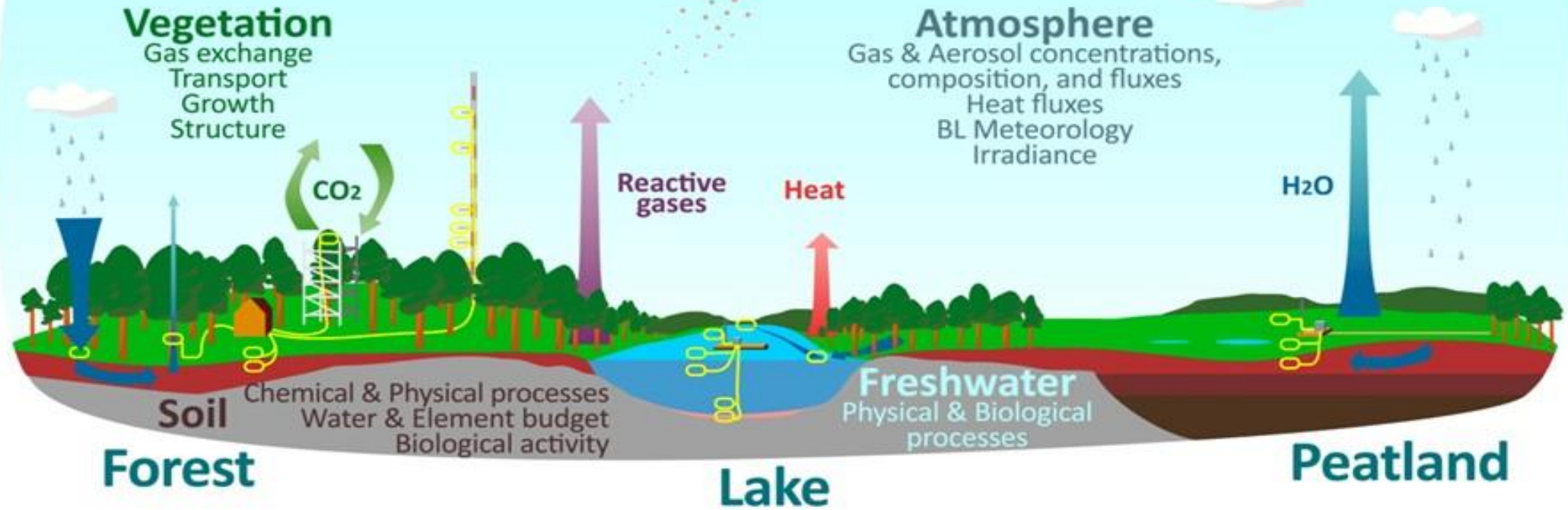
creating conditions for each factor optimal

performance

Continuous comprehensive observations
Station for Measuring Ecosystem - Atmosphere Relations



SMEAR II



Over **1200** different variables

Flagship site for integration: combines all IPCC components. **Contributes to :**



Laboratories: Latest advances in genomics and high resolution microscopy

Soil communities

STABILITY SUSTAINABILITY PRODUCTION

SMEAR: Long term life history datasets

Reveal mechanisms of environmental adaptation from
molecular to global scales

Optimal multi trait responses

PLASTICITY