PHYTOBIOMES ALLIANCE

Embracing Complexity to Achieve a New Vision for Agriculture

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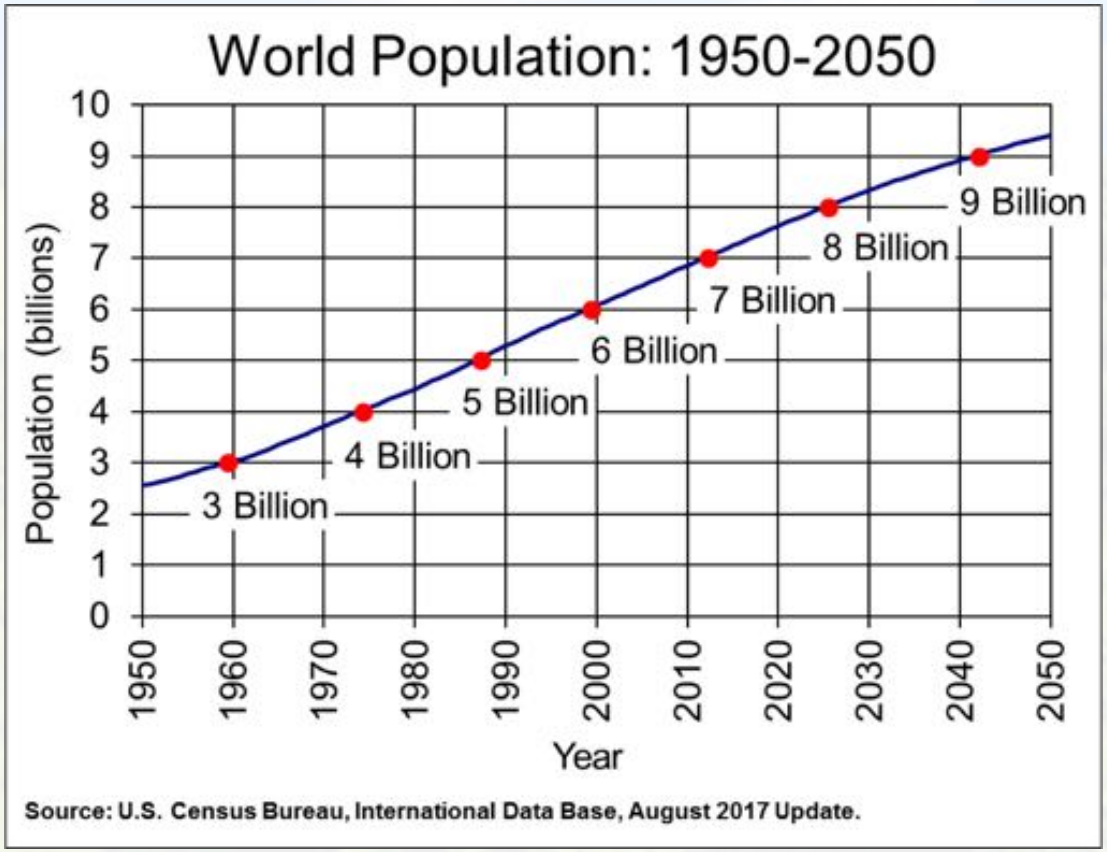
16 February 2018

Symposium: Phytobiome Research to Improve Agricultural Productivity

AAAS ANNUAL MEETING Feb 15–19 2018 ★ Austin, TX

The Challenge



32 Growing Seasons

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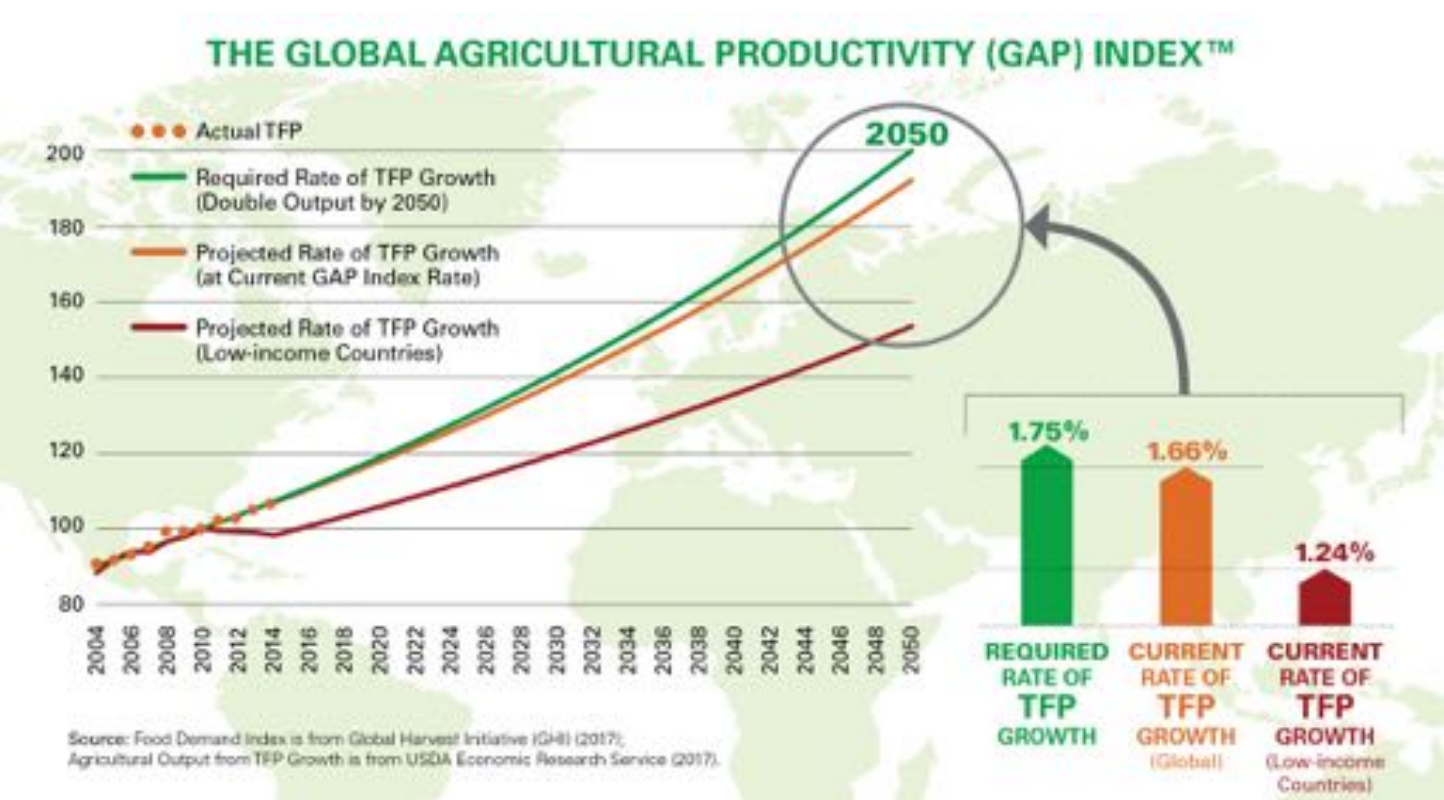


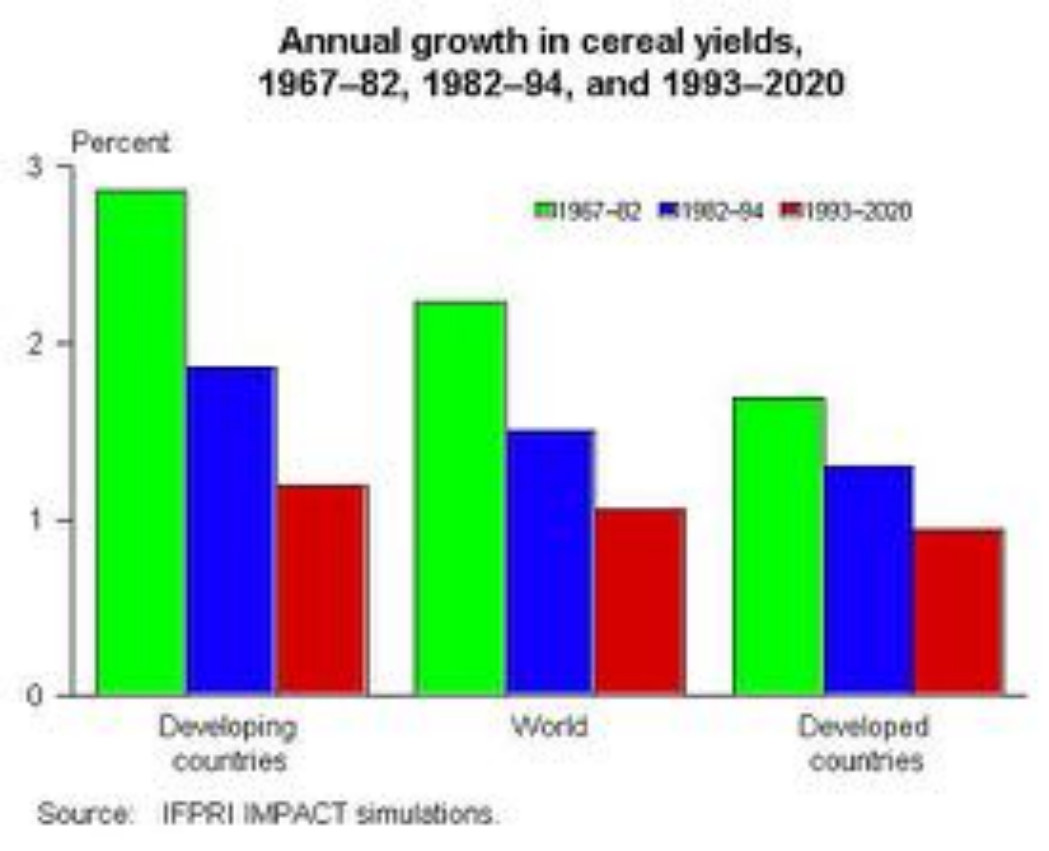
TFP= Total Factor Productivity – the ratio of outputs to inputs

2017 GAP REPORT® GLOBAL AGRICULTURAL PRODUCTIVITY REPORT®

Agricultural Productivity is not rising fast enough to sustainably feed the world in 2050

#GAPReport
@Harvest2050

Declining Cereal Yields



How do we reverse the trend and achieve sustainable production in 32 growing seasons?

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Moving From Simple to Complex

Traditional science approach

- Reductionist
- World is linear and can be understood by focusing on individual components
  - Soils
  - Plant genetics
  - Microbiomes or
  - Weather

Reality – agriculture is a **complex system**

- non-linear organization
- governed by multiple non-linear interactions and environmental variables
- adaptation via learning or evolution
- it can be influenced

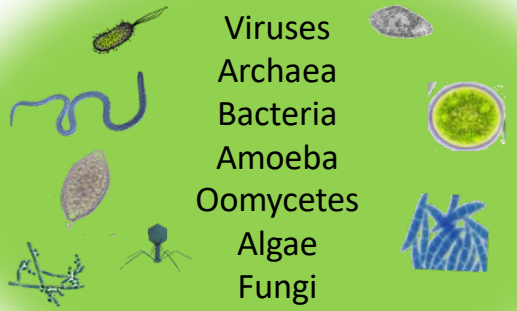
Paradigm shift to a systems approach – the phytobiome

Plant-Based Agriculture: A Complex System

A “Phytobiome”

Climate and Weather

Micro- and Macro-organisms



Viruses
Archaea
Bacteria
Amoeba
Oomycetes
Algae
Fungi
Nematode

“Biome” – Site specific environment

Plants

Soils

Arthropods, Other Animals and Plants

Insects
Arachnids
Myriapods
Worms
Birds
Rodents
Ruminants
Weeds

Associated organisms

Indoor Phytobiomes

Vertical Farming

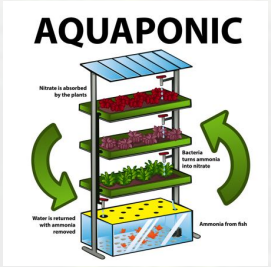
THE WALL STREET JOURNAL.

LIFE

Love Local Farming? Try Your Living Room

In the ultimate locavore move, more households are growing kale, cucumbers and tomatoes with hydroponic setups in kitchens, hallways and dens.

12 February 2018



Holy Grail for Phytobiomics

To understand, predict, and control emergent phenotypes within specific phytobiomes for the sustainable production of food, feed, and fiber

How do we get there?

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INTERNATIONAL ALLIANCE
FOR PHYTOBIOMES RESEARCH

A nonprofit consortium of industry, academic, and governmental scientists

Phytobiomes Alliance

Our **mission** is to establish a science and technology foundation for site-specific, phytobiome-based enhancement of sustainable food, feed, and fiber production

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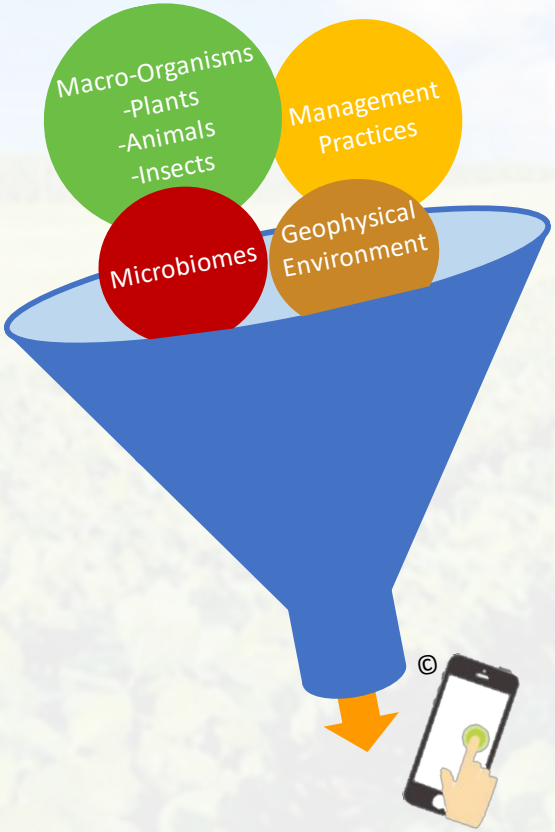
Phytobiomes Alliance Vision



By 2050, all farmers have the ability to use predictive and prescriptive analytics based on geophysical and biological conditions for determining the best combination of crops, management practices, and inputs for a specific field in a given year.

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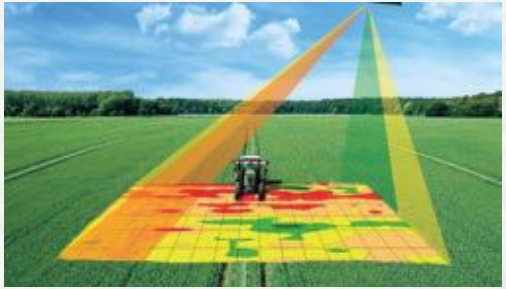
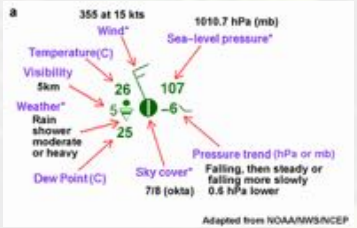
Why Now?

- Omics-enabling technologies and data
- Systems-level methods - convergence
- Advances in computational science
  - Machine learning, deep learning
  - Analytics
  - Predictive analytics
  - Quantum computing
- Precision Agriculture
  - Variable rate technology…seeding & input
  - Unmanned Aerial Systems (UAS)
  - Soil, plant, & weather sensors
  - Robots





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Strategies

- Focus on pre-competitive science
- Determine research, resource, and technology gaps and develop roadmaps to fill them
- Coordinate and manage projects to address gaps
- Facilitate international and public-private collaborations
- Develop an interdisciplinary community of researchers committed to advancing phytobiomes science
- Empower industry growth and profitability

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Fundamental Research Areas

- Universal, common, and environment-specific trends in microbiome composition
- Mechanisms by which distinct phytobiome components interact
- Genetic linkages that connect phytobiome components
- Impacts of phytobiome components on plant health
- Multidirectional feedbacks that influence phytobiome components

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Short-term Priorities

- Databases that support correlation studies between biological and geophysical phytobiome components
  - Whole genome & 16S microbe sequences, metagenomics
  - **Metadata** to include crop, variety, soil characteristics, weather and climate, management practices
- Standards (minimum information, sampling, reference datasets…)
- Genome sequence-based classification system for microbes
- Preliminary crop models for several agroecosystems (cereals, vegetables, forage, trees…)
- Regulatory science roadmap for microbials
- 3 to 5 year strategic roadmap with specific deliverables

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Longer-term Targets

- Simple, simulation models that are functionally accurate to real world complex conditions – e.g., greenhouse studies that reflect field conditions
- Validated and optimized models
- Trait- and gene-based microbial genomics datasets
- Integration of microbial data with databases and equipment used in precision agriculture
- Systems level predictive and prescriptive analytics for on-farm implementation

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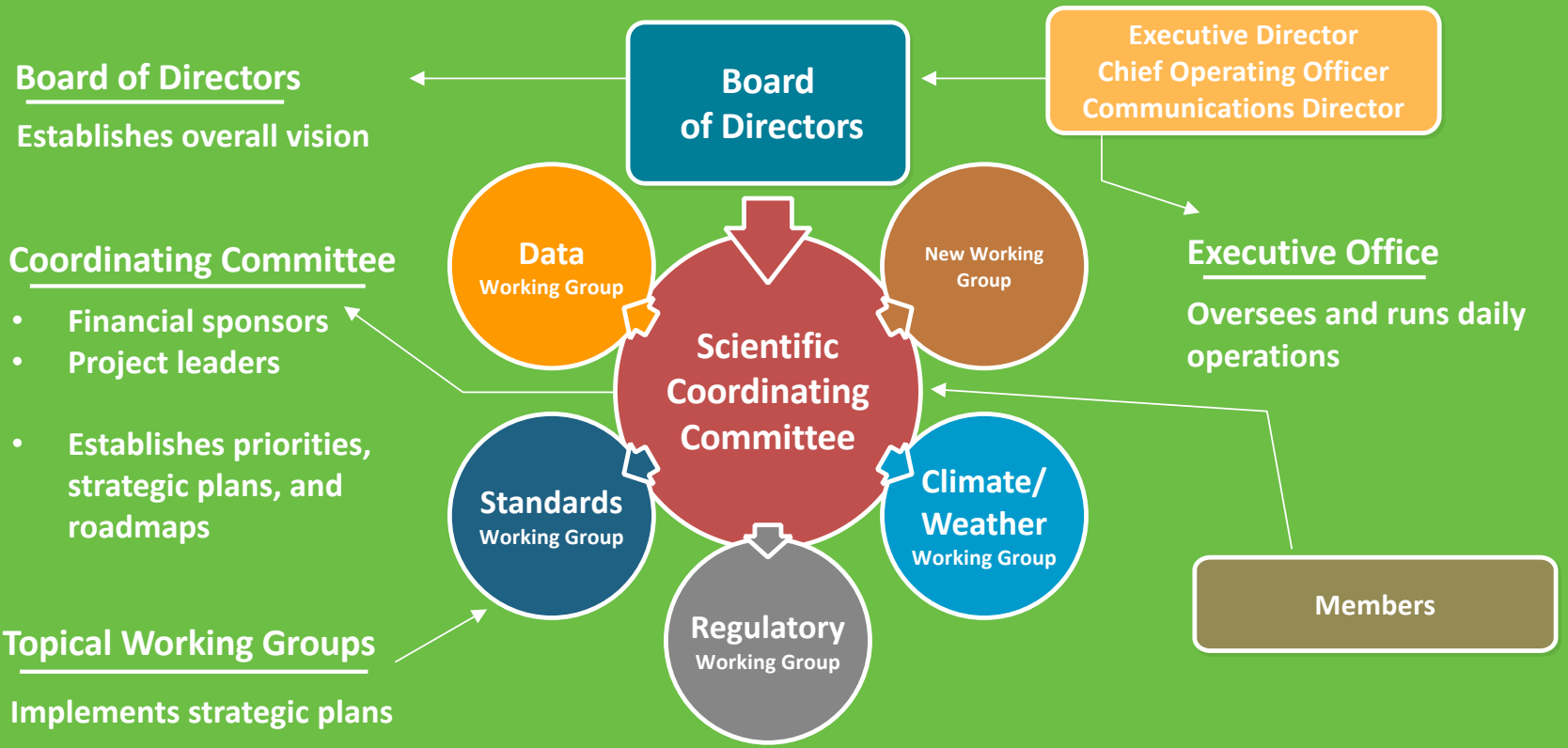
Phytobiomes Alliance Organizational Structure



Upcoming Meetings

- Phytobiomes Research Symposium, France (in planning for late 2018)
- Phytobiomes Database workshop (in planning)
- Regulatory Science workshop (2019)
- Keystone Symposium on Phytobiomes, 2019

Join Us!

Scientific Coordinating Committee

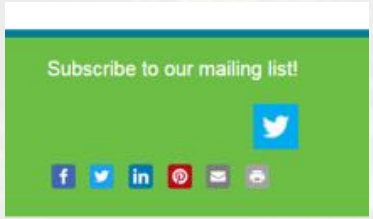
- ✓ Alliance sponsors
- ✓ Project leaders

Alliance working groups

- ✓ Overall topical leader
- ✓ Involved in projects aimed at filling gaps in knowledge, resources, or tools

Subscribe to Mailing List

- ✓ www.phytobiomesalliance.org



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BioConsortia

Thank you for your attention!

www.phytobiomesalliance.org