



Food and Agriculture
Organization of the
United Nations

FAO  **SCIENCE AND
INNOVATION**
FORUM

Innovations in Soil and Plant Nutrient Management

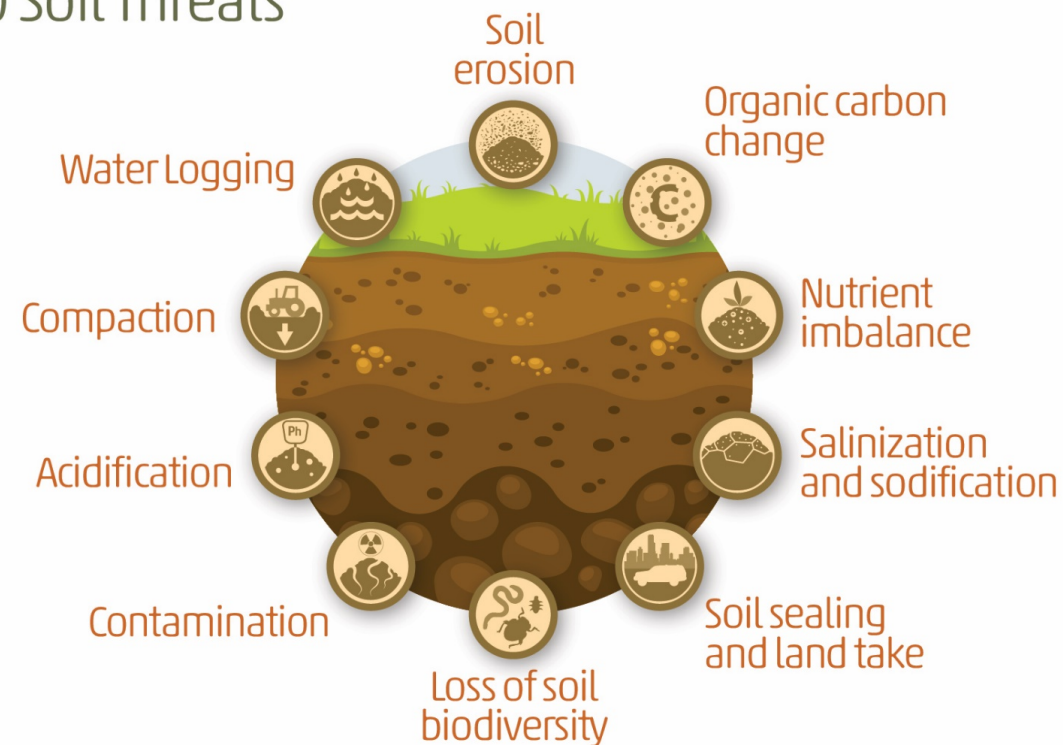
Outcomes of the Global Symposium on Soils
for Nutrition: a joint plan of action on soil fertility
beyond 2030

Ronald Vargas

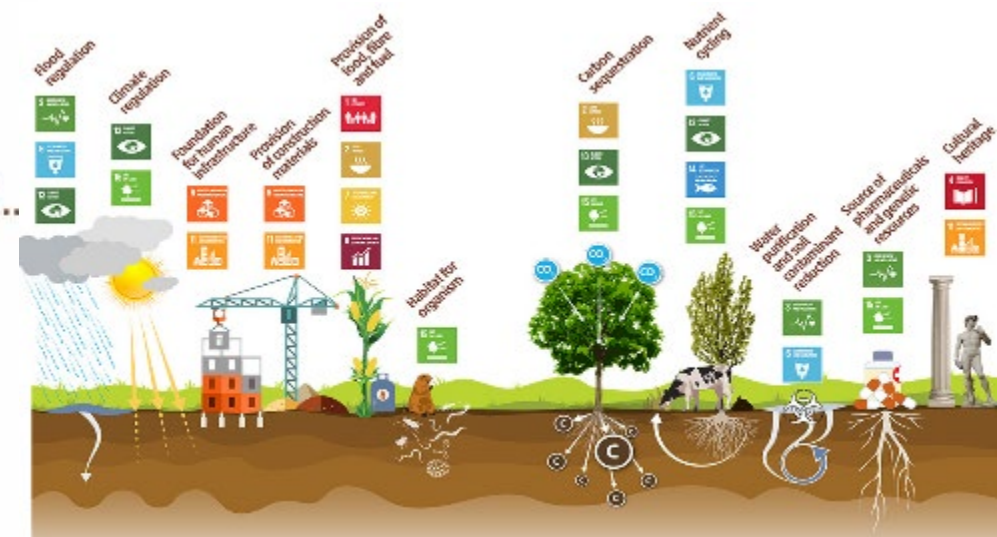
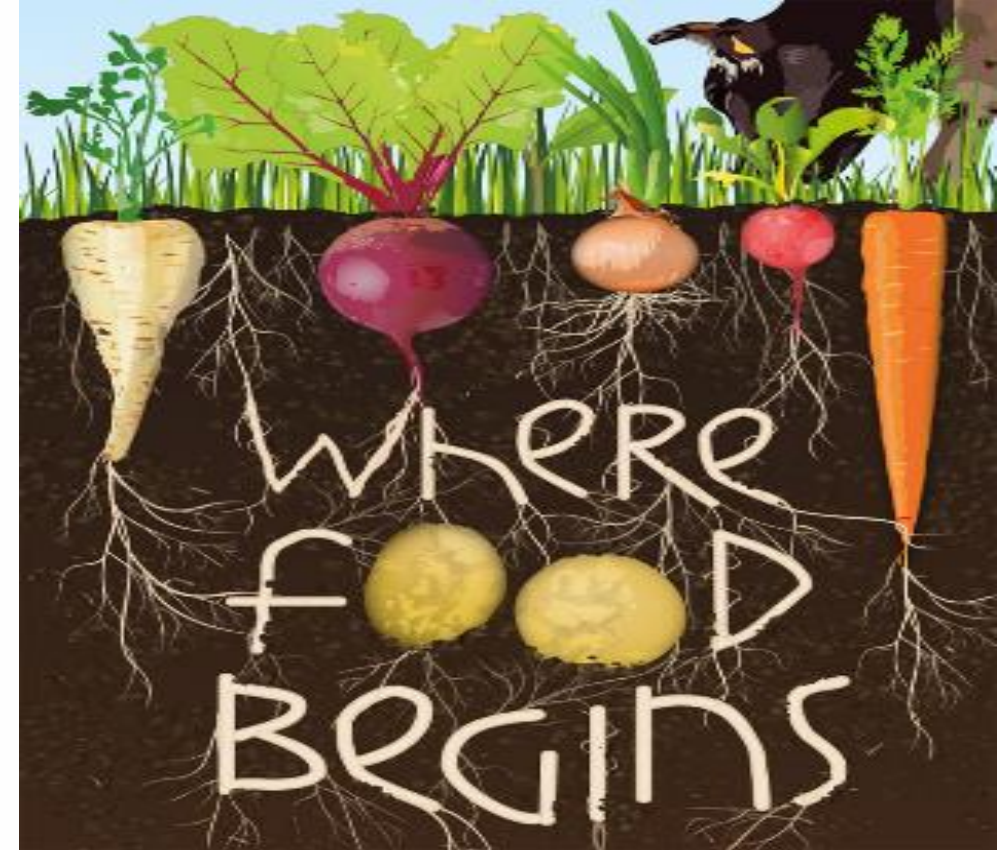
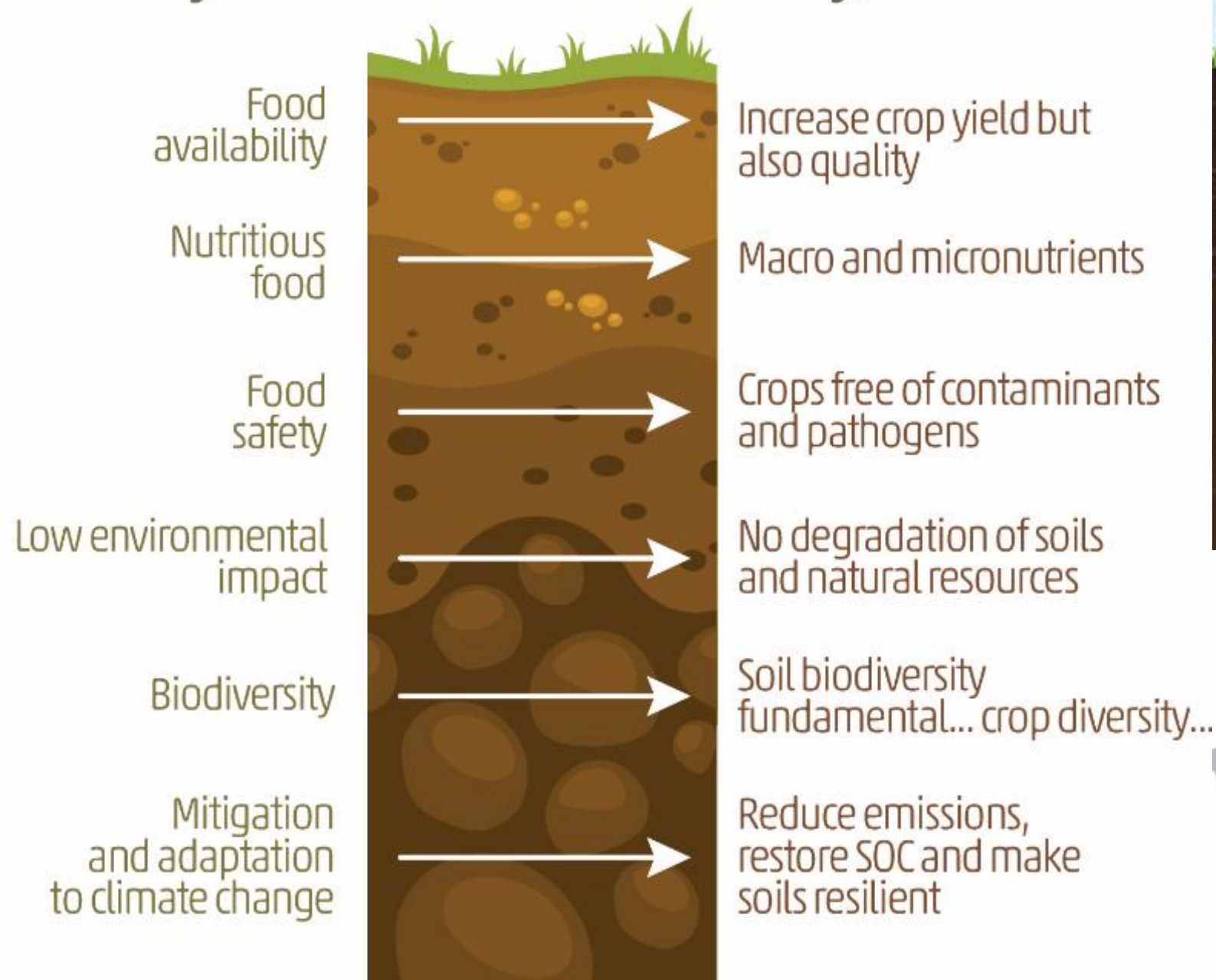


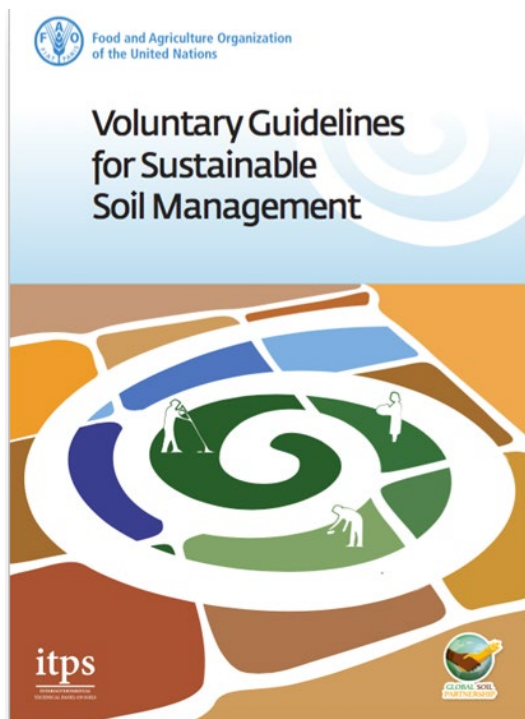


10 Soil Threats



Healthy soils and Food Security/Nutrition

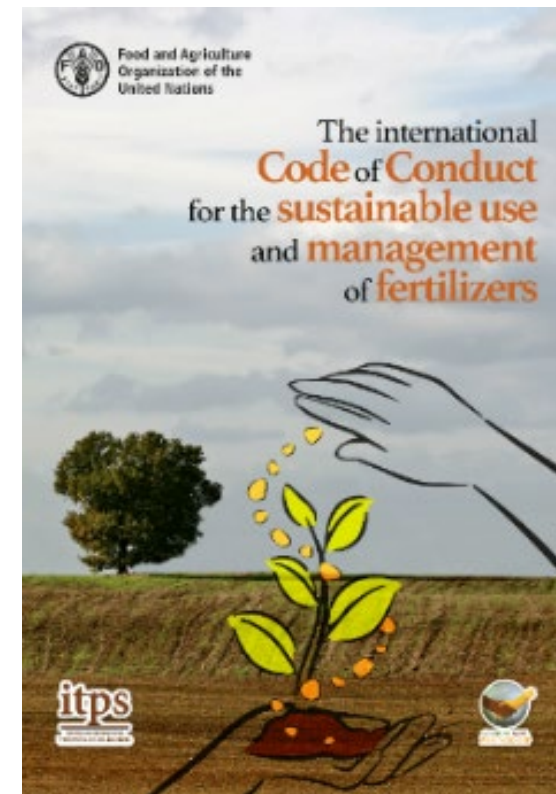


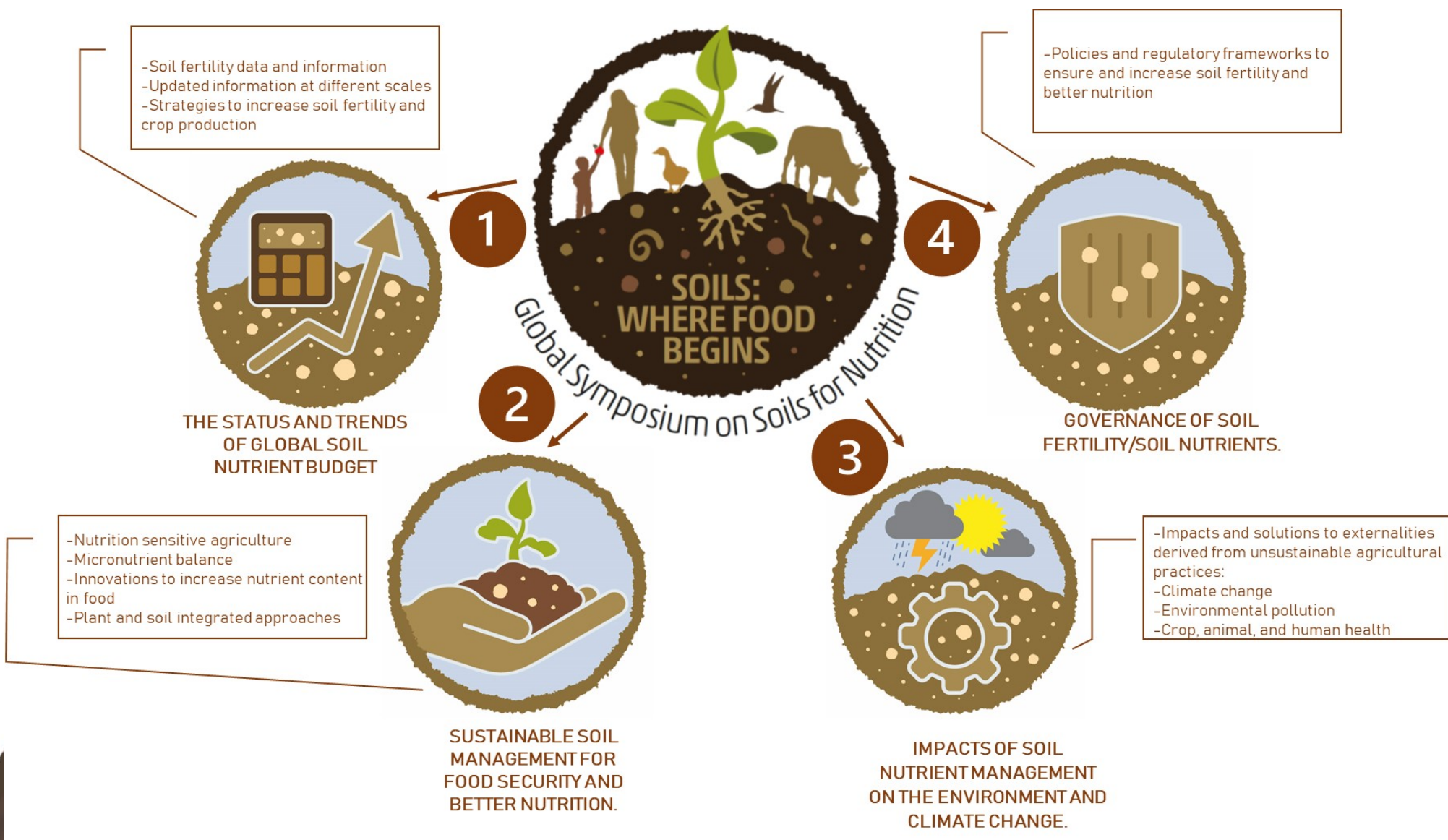


Soil management is not a short term activity! It requires a long term perspective to build its resilience!



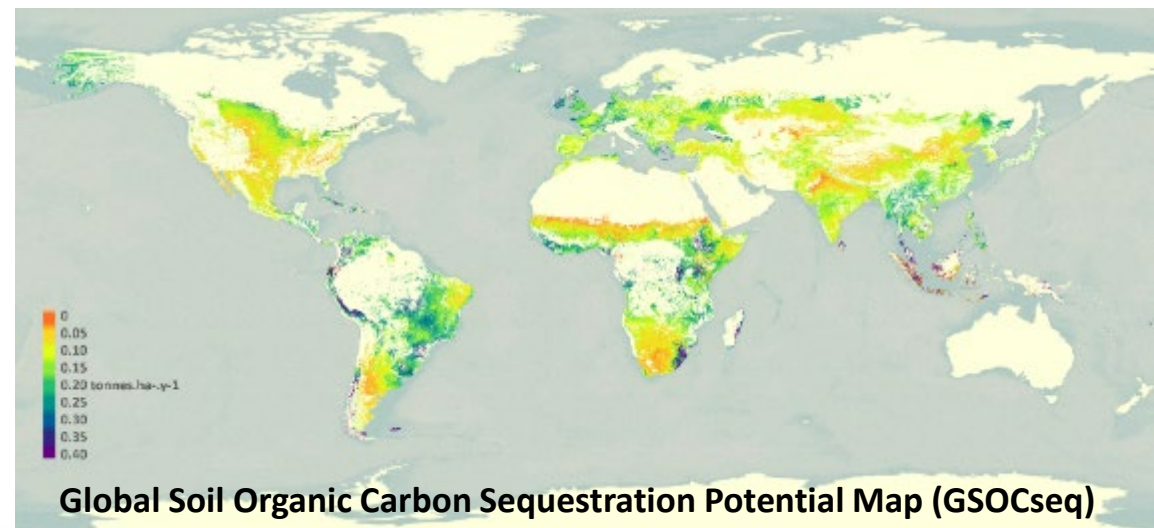
Sustainable Soil Management

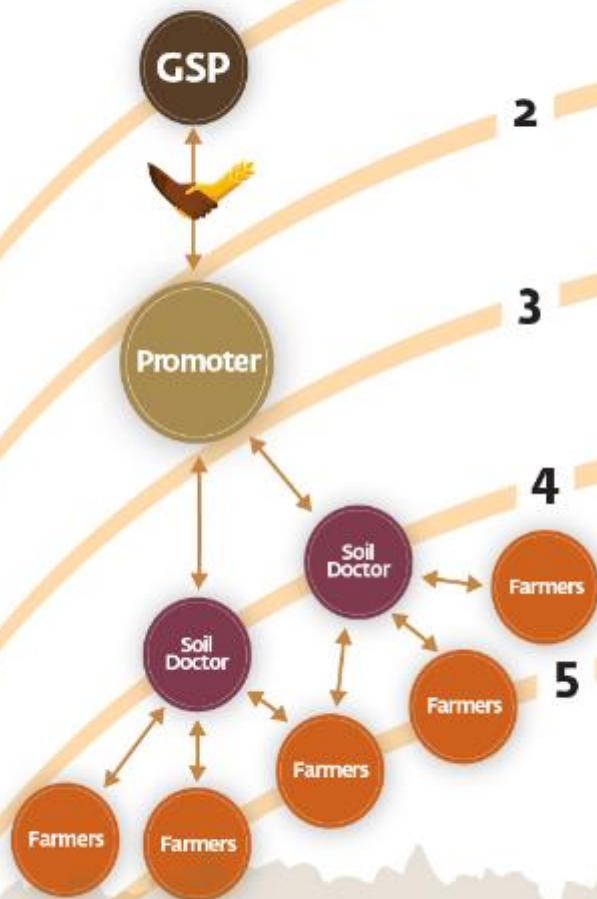
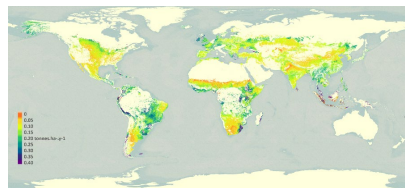




How can we manage something we do not know?

- **Assessing and mapping soils and building National Soil Information (monitoring) Systems is the start.**
- **Uncertainty/quality is fundamental, and that starts with the Soil Laboratories (standard operating procedures and quality control).**





- 1 The Global Soil Partnership and the Promoter agree on the **implementation plan**
- 2 The Global Soil Partnership **trains** the **Promoter**
- 3 The Promoter **identifies farmer groups** and selects **potential Soil Doctors**
- 4 **Training of the Soil Doctor** by the Promoter
- 5 **Training of the Farmers** by the Soil Doctor

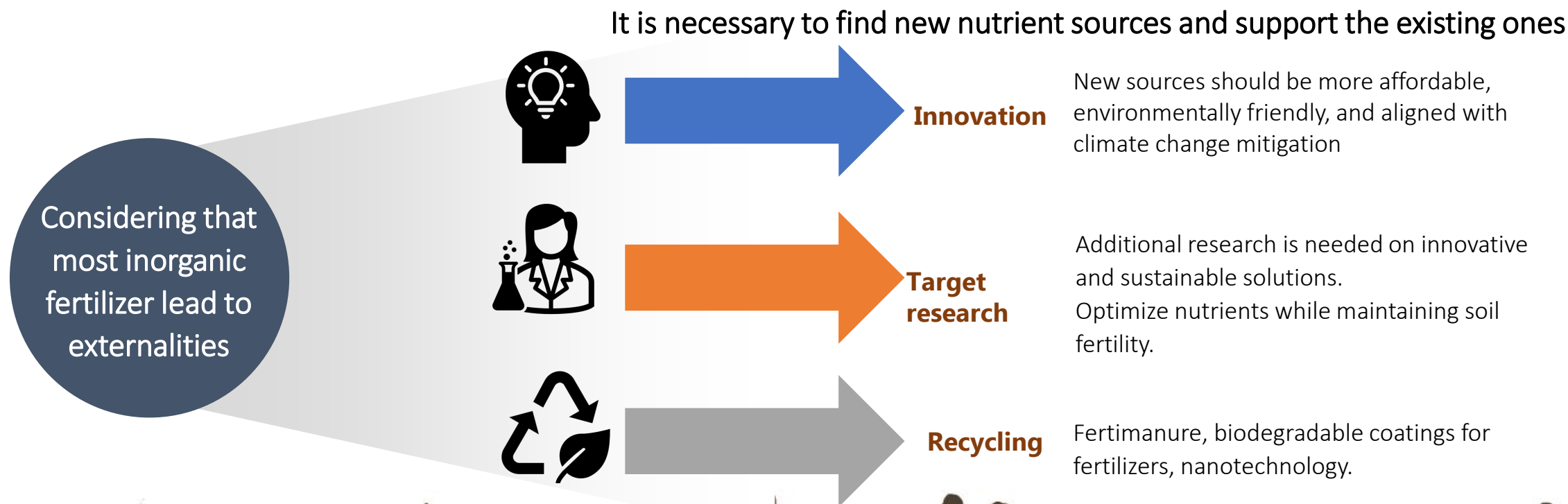


Global **Soil Doctors** Programme



Región Lagunera, noviembre 2021

Innovation is key to move forward from the environmental impact of mineral and inorganic fertilizers to improved efficiency, alternative nutrient sources, and quality assessment



Plant growth and development

- Increased aboveground biomass
- Higher yield (quantity & quality)
- Resiliency to constraints (abiotic & biotic)

Root growth, plasticity and architecture

- Biomass, length, surface
- Soil exploration
- Nutrient cycling
- Nutrient use

Root and soil microbial diversity

- Bacterial and fungal communities shift
- Rhizosphere (soil and root-associated) microbes diversity
- Recruitment of beneficial microbes

Mycorrhizosphere

AMF

Arbuscular mycorrhizal fungi

- C supplying
- Selective PSB recruitment

- P supplying
- N supplying
- Micronutrient supplying

Microbial synergism
Competitive advantage
Enhanced efficiency

PSB

Phosphorus solubilizing bacteria

- P supplying

BNF

Biological nitrogen fixation

Provider / supplier of

- Bioavailable nutrients (i.e. N, P, K, S, micronutrients)
- Energy rich C compounds & exudates
- Phytohormones
- Vitamins
- Siderophores
- Antimicrobials

Microbial
with higher
y and less
inputs

Emissions
 N_2O N_2O

Leaching
 NO_3^- NO_3^-

Rhizobium
fixing
bacterial
nods

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N_2 -fixing

Growth
promoters

P-solubilizing
bacteria

availability, and plant and soil protection.

croplands, such as increasing water availability, soil carbon
fertility hot-spots, and increases soil resilience to climate

management | 20 October 2022

Opportunities

Biofertilizers: harnessing soil biodiversity

- **Several sources:** single strains, N_2 Fixing rhizobia, plant growth promoting, fungal inoculants.
- **The challenge:** oversimplification of plant-microbe interactions and quality control.
- The present and future approach should be to **embrace complexity!** Mixed or complex biofertilizers with a top-down approach (based on the existing microbiome).

Biostimulants: Acting to enhance the natural processes

- **Variety of sources** used as biostimulants: seaweed and plant extracts, humic and fulvic acids, hydrolyzed proteins, and micro-organisms.
- **Challenges:** Specific information is needed in terms of the advantages of different biostimulants' effects on a variety of crops, soil types, and climatic conditions.
- **Monitor quality**, based on scientific evidence of efficiency.



Recycled nutrient source



Wastes are not waste
be new sources of nutrients
aligned with a circular
economy, reducing carbon footprint.

Challenges: quality evaluation (including strict
specification of nutrient sources), operational costs,
accessibility,



- Energy and material input
- Aquatic plants
 - Sewage sludge
 - Biosolids
 - Animal manure
 - Urban wastes
 - Composts
 - Vermicomposts
 - Digestate
 - Biochar
 - Inorganic or organic byproducts such as:
 - struvite
 - ammonium sulfate
 - and residues from food and agroindustries



Innovation? Yes, but hand in hand with quality assessment/monitoring of all nutrient sources!

- It is necessary to assess and monitor the quality and efficiency of **traditional and new sources** of nutrients.
- It is especially relevant in the case of **new or recycled** sources to support their implementation in bigger scales.
- Fertilizer quality assessment is the **best ally against undesirable effects** of nutrient sources on environmental quality, and human and animal health.
- Assessments of **biodegradability** of different materials used in agriculture, including plastics, and fertilizer coatings.
- **Well-equipped laboratories** for testing efficiency, quality, and safety are necessary

Fertilizer quality assessment

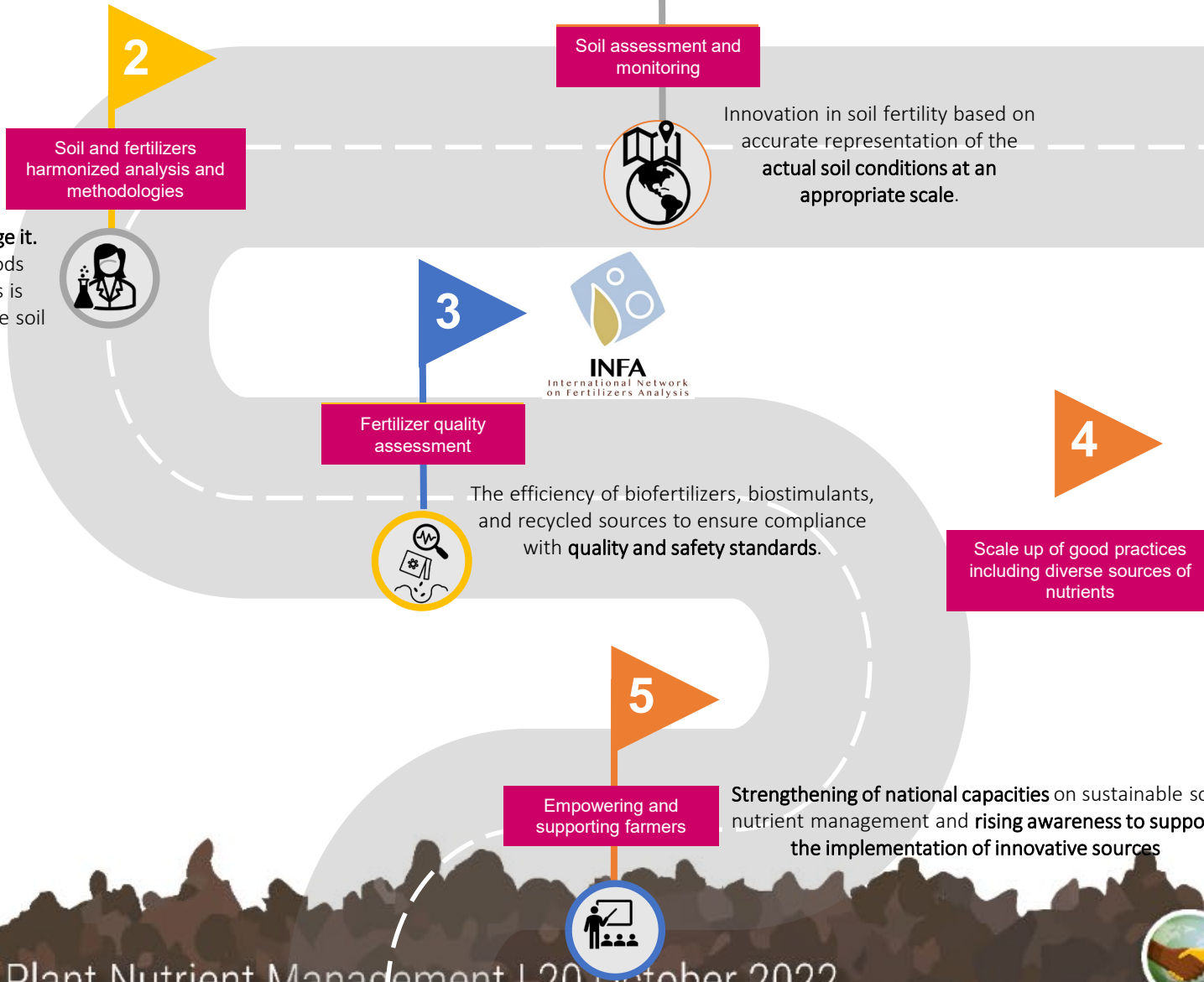


The quality of fertilizers and their bioavailability ensure that fertilizers and recycled nutrients are compliant with **quality and safety standards**.



Supporting farmers for ensuring crop yields today and building soil health forever!

If you cannot measure it you cannot manage it.
Monitoring soil fertility innovative methods
through standardized analytical methods is
critical to providing reliable and comparable soil
information.





Thank you!