
Food and Agriculture Organization of the United Nations
Insoilfer
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Intergovernmental Technical Panel on Soils
INSOILFER Technical Committee
30 January 2024
13:00 -15:00 CET
Soil health as a prerequisite for crop production: the relevance of organic fertilizers
GLOBAL SOIL PARTNERSHIP

Soil provides 95% of the food we eat. A third of soil globally has already degraded, reducing the quality and quantity of crops and food produced.
Over 60% of European soils are unhealthy due to unsustainable management of the land, sealing, contamination and overexploitation, combined with the impact from climate change and extreme weather events.

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Soil health as a prerequisite for crop production: the relevance of organic fertilizers

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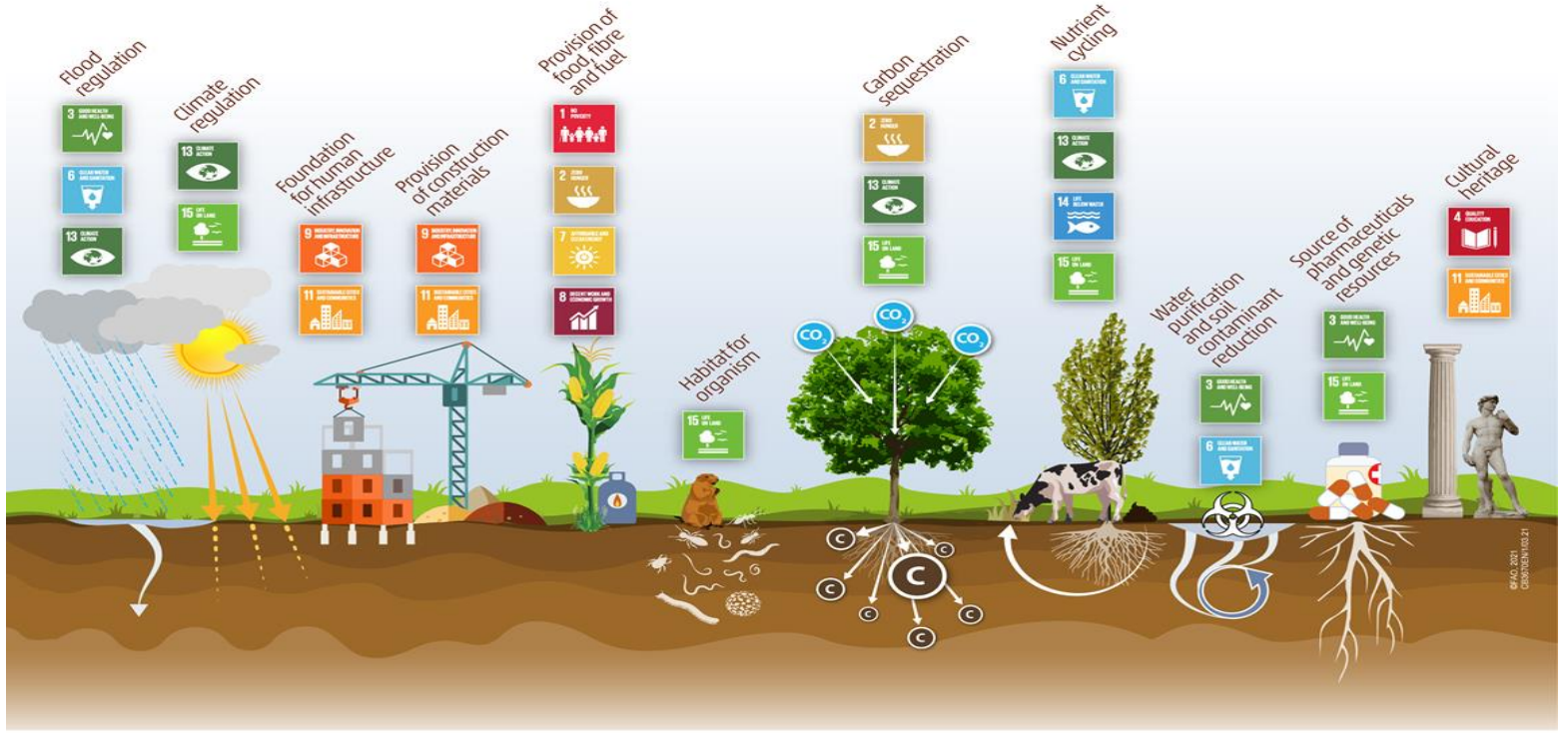
Healthy soils
a prerequisite to achieve the SDGs



"The global economic value of soil ecosystem service is approximately 1.5 trillion dollars per year."

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SUSTAINABLE DEVELOPMENT GOALS

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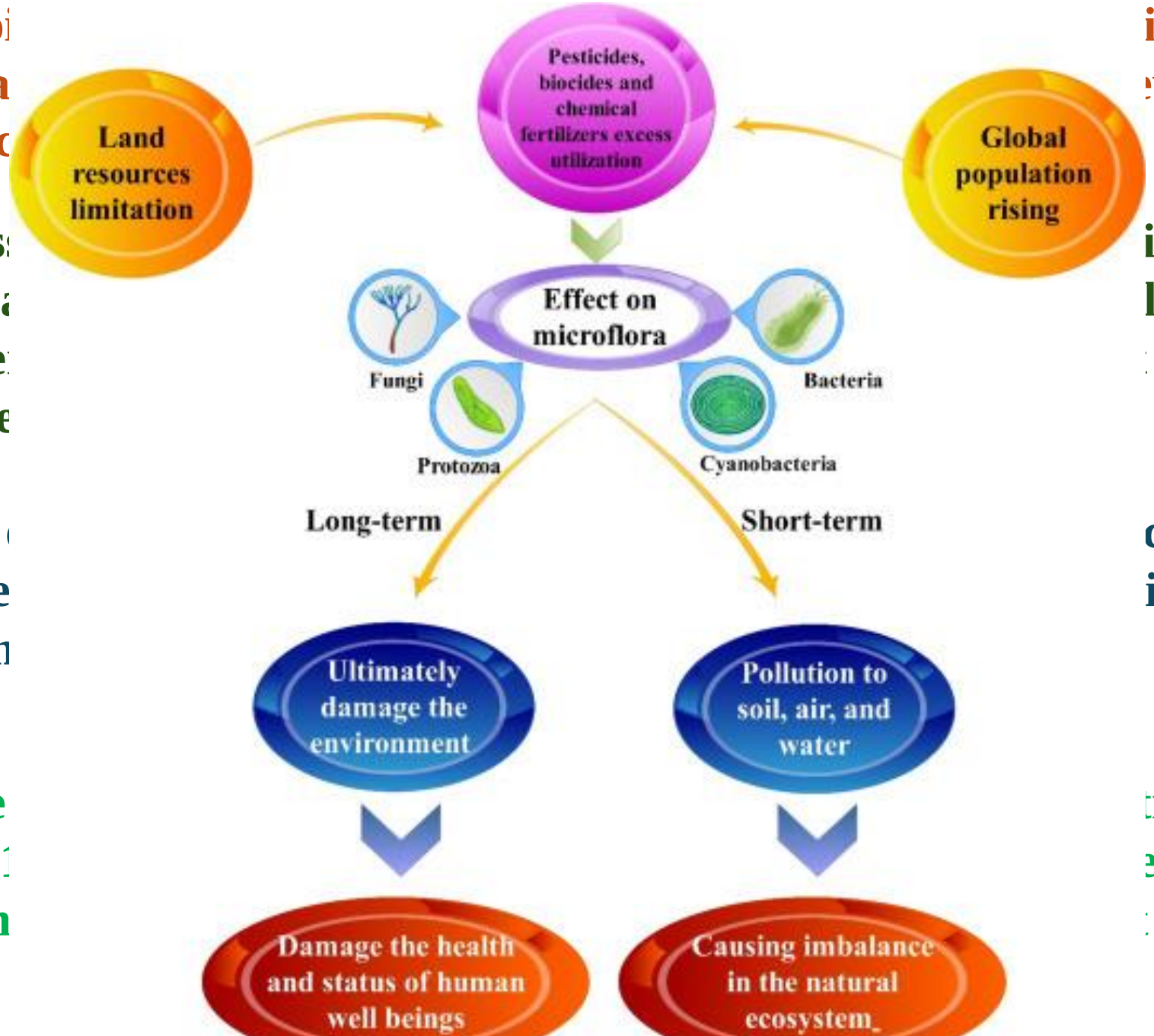
Healthy soi ificial fertilizers, which ma evere long-term consequenc

To addres itioned towards utilizing na lizers. This shift aims to e of sustainable farming, le

The use of cost-effectiveness, enhanceme il water retention abilities, an

A better use igation, storing up to an extra 1 es of CO_2): around the same am sector.



What are organic fertilizer made off?

Organic fertilizers are composed of naturally derived raw materials from plants or animals. The nutrients found in the organic raw materials, including nitrogen, phosphorus, potassium, and other essential elements, are gradually released into the soil by the breakdown operated by soil organisms, including beneficial bacteria and fungi.

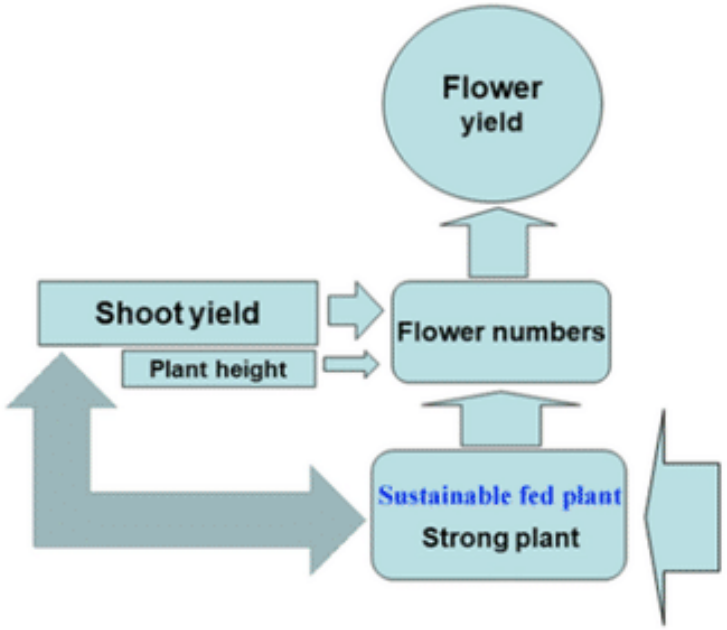
How does organic fertilizer work?

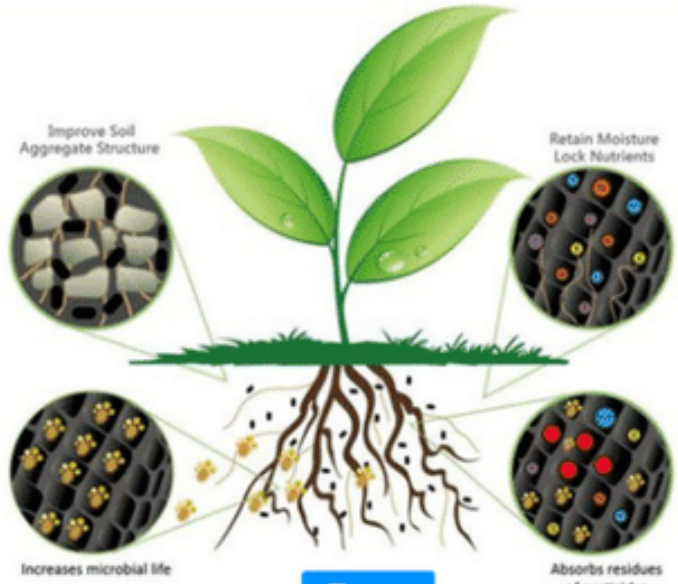
- **Direct mechanisms encompass the release of nutrients into the soil solution and maintaining nutrient balance for healthy growth of crop plants; act as an effective energy source of soil microbes; significantly increase microbial community composition and diversity.**

- **Indirect mechanisms include changes in bulk density, water holding capacity, soil structure, that consequently affect soil biodiversity and the metabolic activities of microorganisms, such as enzyme activities and nutrient cycling.**

The efficacy of fertilization is contingent upon various factors, including the type and composition of the fertilizer, the chosen culture systems (monoculture versus polyculture), species combinations, population density, and prevailing environmental conditions.

Differences between Organic and Chemical Fertilizers





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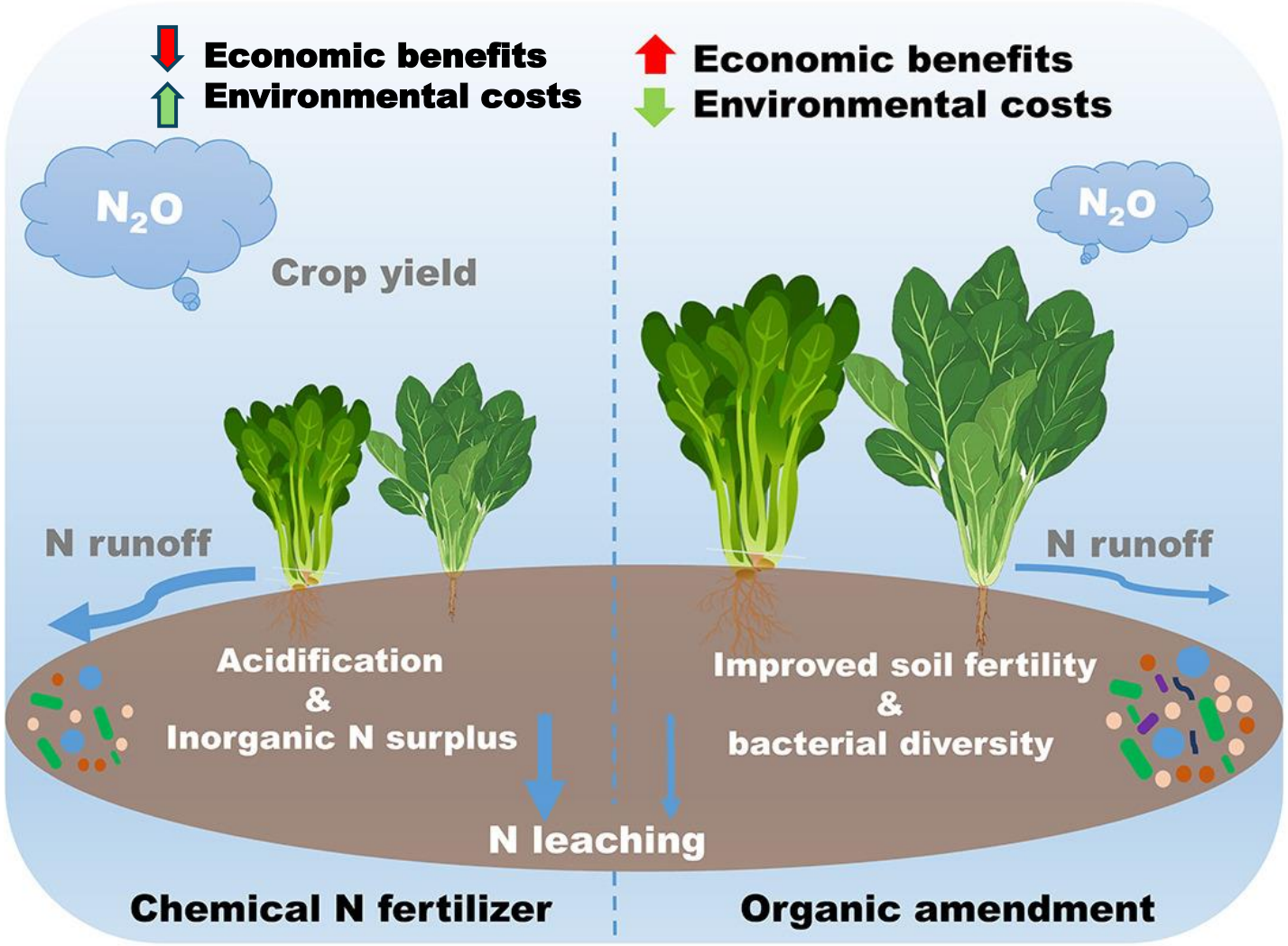
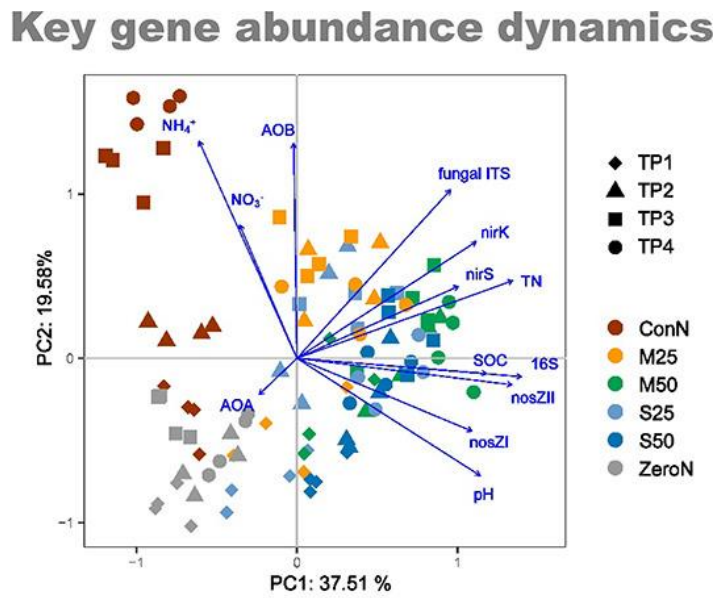
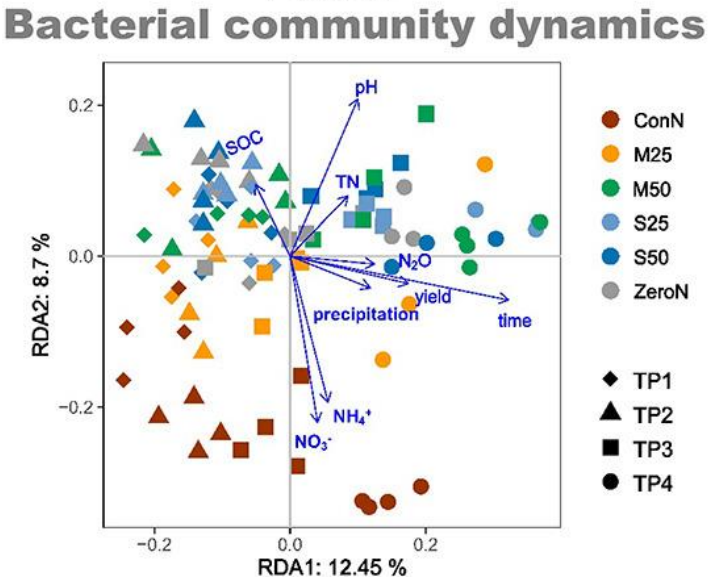


Source: Tang et al., 2022





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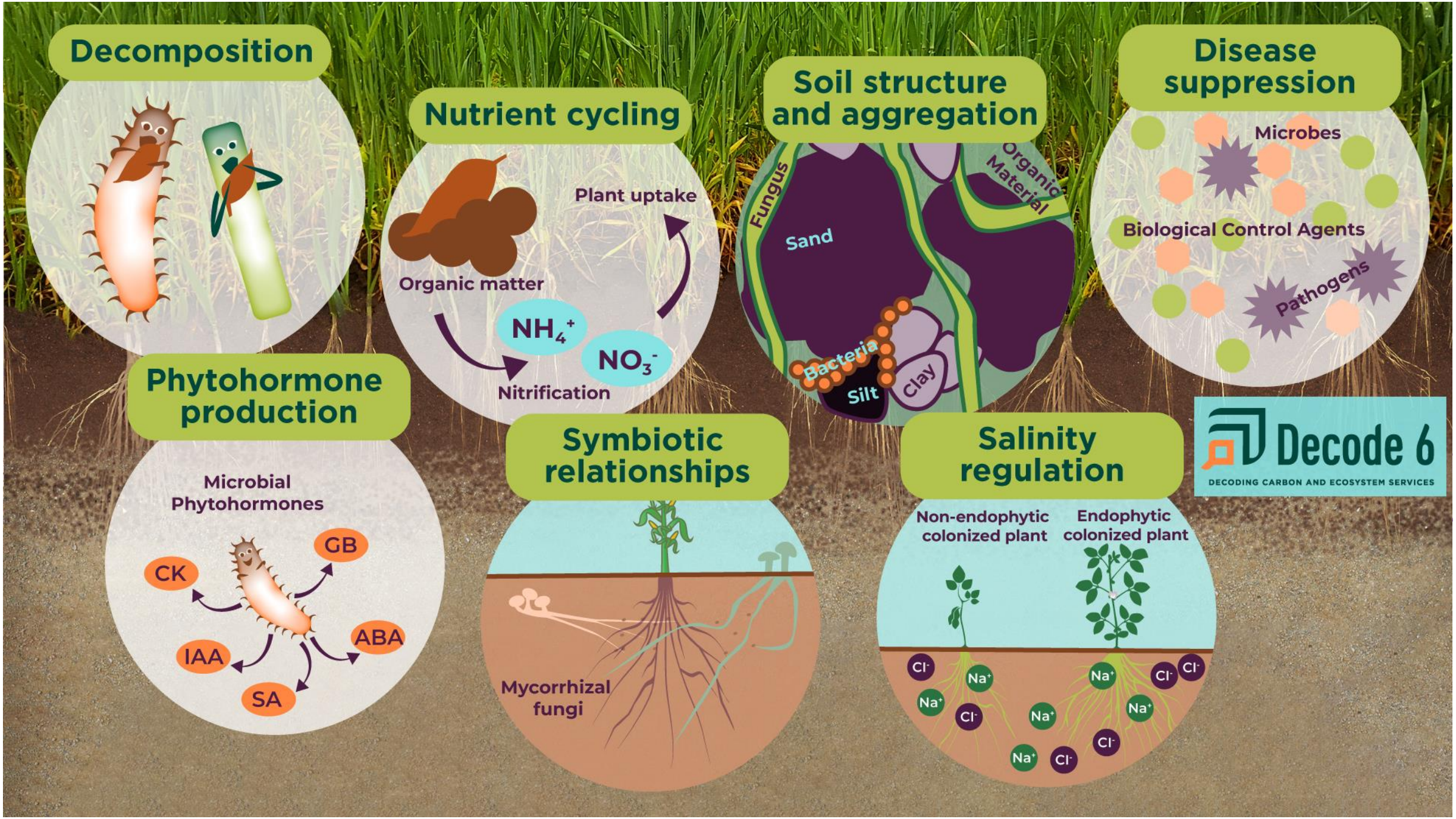
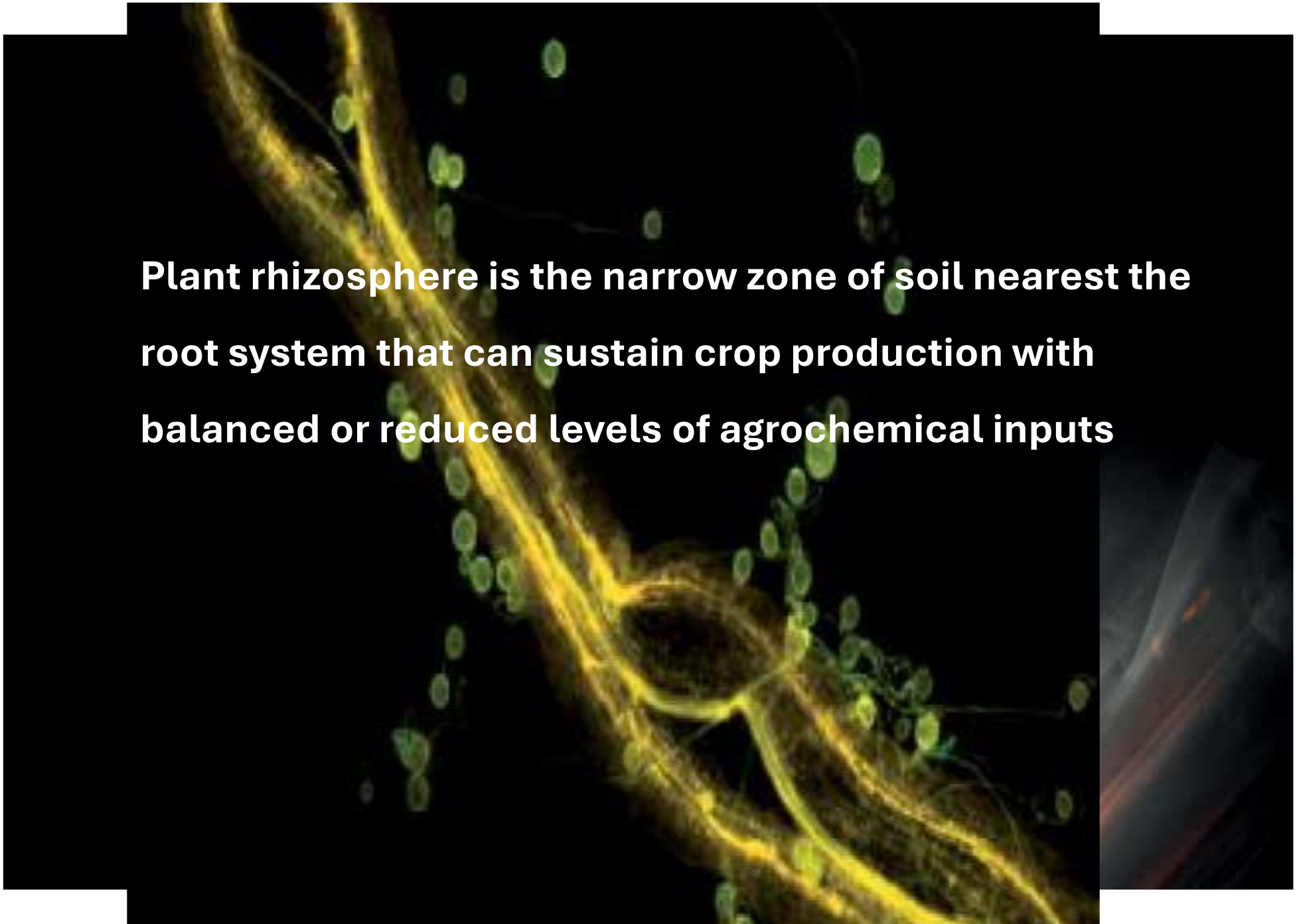
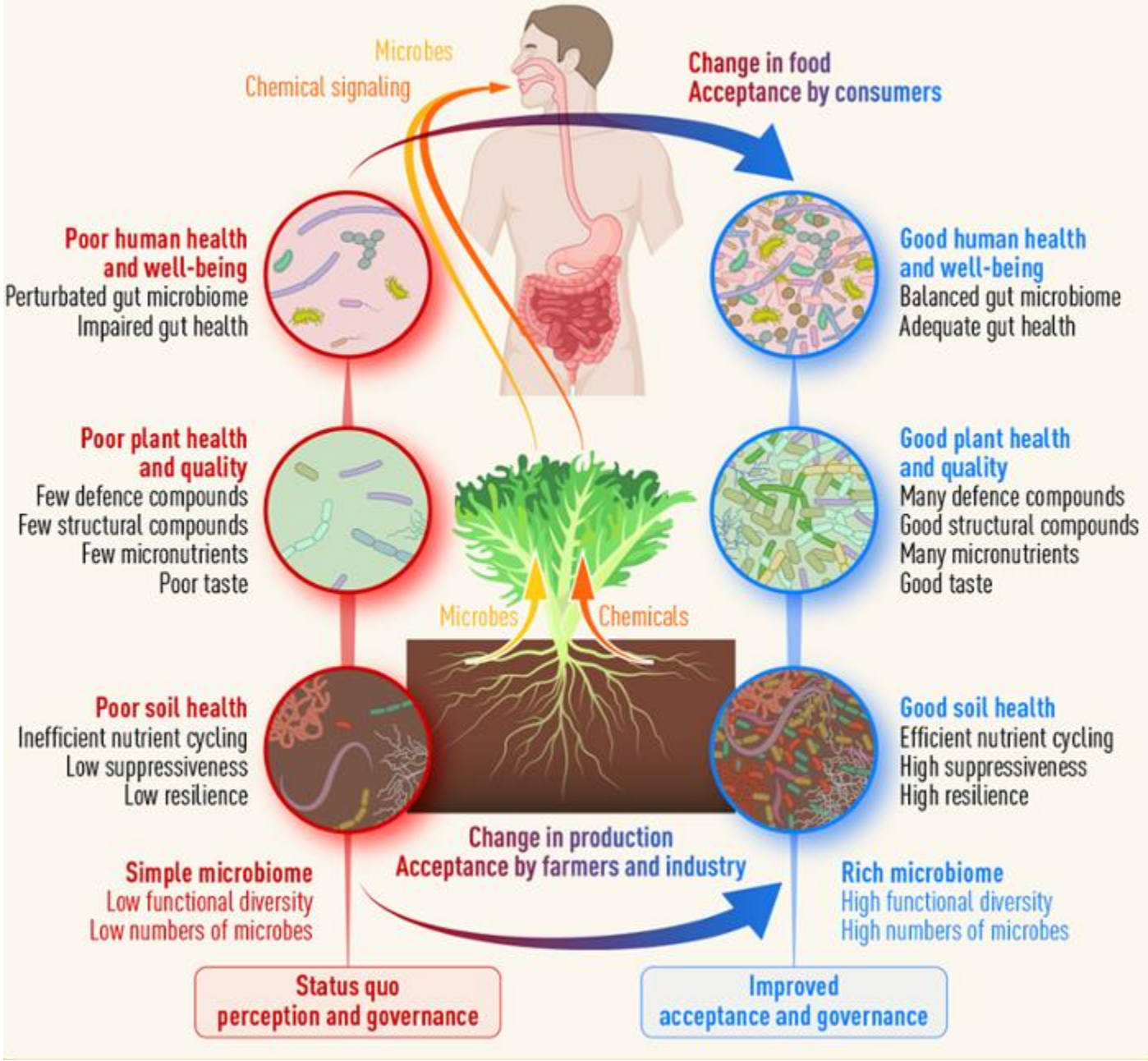

Decomposition
Nutrient cycling
Plant uptake
Organic matter
NH_4^+
NO_3^-
Nitrification
Soil structure and aggregation
Fungus
Organic Material
Sand
Bacteria
Silt
Clay
Disease suppression
Microbes
Biological Control Agents
Pathogens
Phytohormone production
Microbial Phytohormones
GB
CK
ABA
IAA
SA
Symbiotic relationships
Mycorrhizal fungi
Salinity regulation
Non-endophytic colonized plant
Endophytic colonized plant
Cl^-
Na^+
Decode 6
DECODING CARBON AND ECOSYSTEM SERVICES

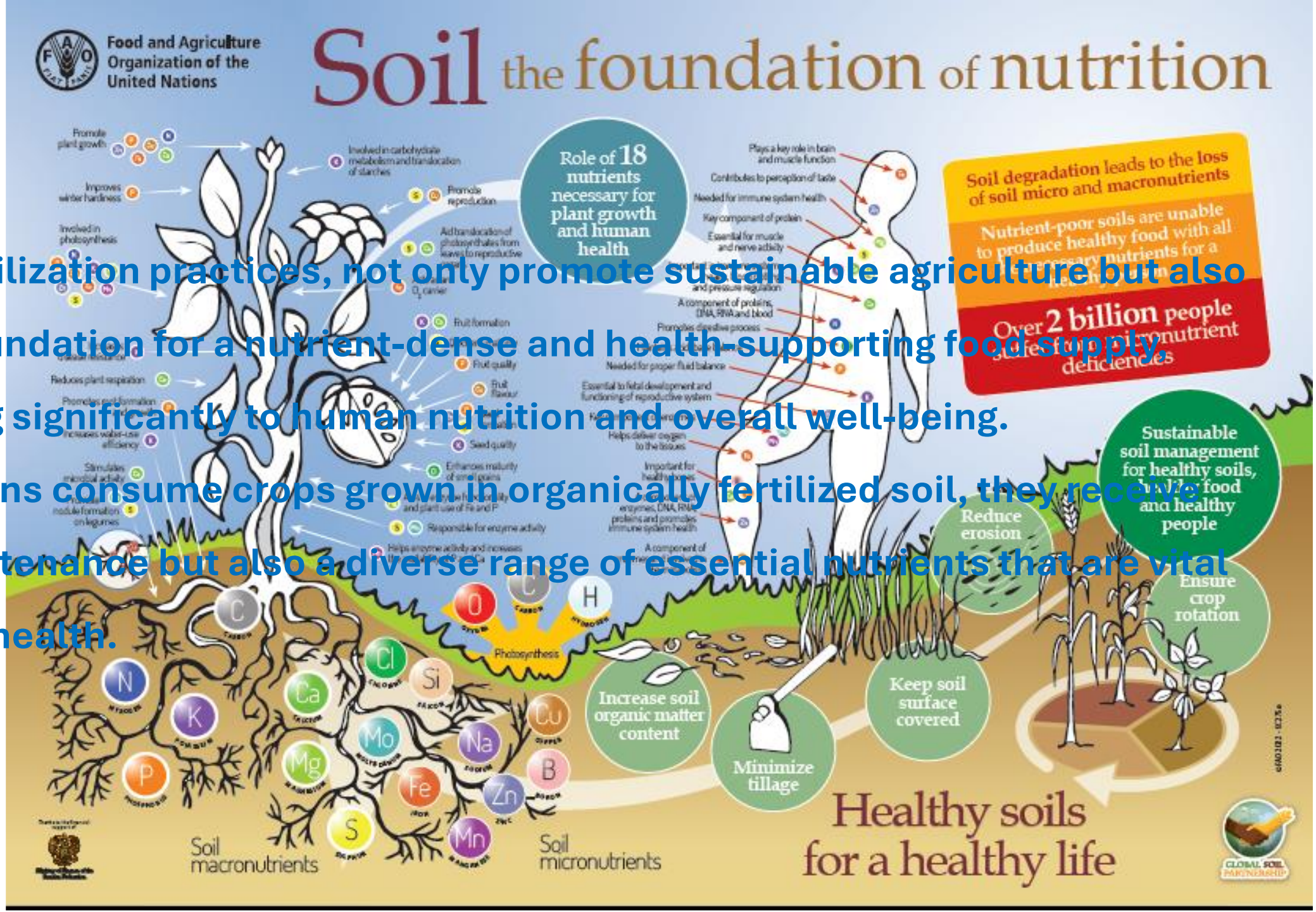

Plant rhizosphere is the narrow zone of soil nearest the root system that can sustain crop production with balanced or reduced levels of agrochemical inputs

There is a direct and crucial connection between soil health and human health.



Organic fertilization practices, not only promote sustainable agriculture but also ensure a foundation for a nutrient-dense and health-supporting food supply, contributing significantly to human nutrition and overall well-being.

When humans consume crops grown in organically fertilized soil, they receive not only sustenance but also a diverse range of essential nutrients that are vital for optimal health.



Fertilizers from wastes

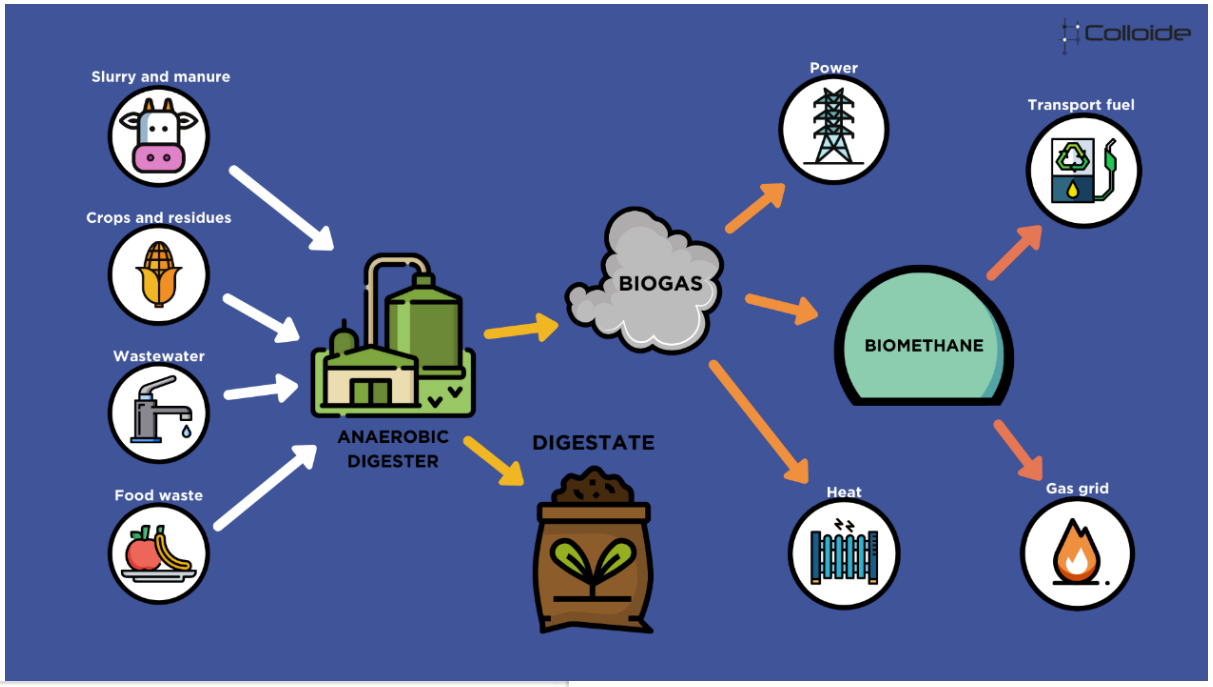
- **In recent times, there has been a significant emphasis on the research and development of using organic wastes to produce fertilizers with the intention of bringing them into commercial use.**

- **Transforming food and agricultural residues into fertilizers holds the promise of diminishing their environmental footprint. This approach not only enhances soil nutrition levels but also reduces the reliance on synthetic fertilizers, directly benefiting food production.**

Fertilizers produced with wastes represents an example of circular economy.

- **The predominant technologies employed include anaerobic digestion, aerobic digestion, and biotechnology, which are utilized for generating organic by-products enriched with microorganisms.**

- **All of the end products: digestate, compost, vermicompost result in amendments and fertilizers with good properties**



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Physical and chemical properties of potted alkaline sandy-loam soils, with the addition of sulfur-bentonite orange waste, digestate and compost from orange wastes

	CTR	Sulfur-bentonite-orange residue fertilizers	Digestate	Compost
Texture	SL	SL	SL	SL
pH	8.5 ^{a} ±0.60	8.0 ^{a} ±0.80	7.2 ^{a} ±0.40	7.5 ^{a} ±0.20
EC	350 ^{c} ±14	410 ^{a} ±10	437 ^{b} ±12	479 ^{a} ±8.00
WC	21.5 ^{b} ±2.81	29.4 ^{a} ±0.79	21.2 ^{ab} ±1.70	26.8 ^{a} ±1.76
WSP	14 ^{c} ±2.80	40 ^{b} ±1.60	39 ^{b} ±3.26	90 ^{a} ±4.00
OC	0.9 ^{b} ±0.16	2.1 ^{a} ±0.15	1.5 ^{b} ±0.25	1.8 ^{a} ±0.30
TN	0.15±0.01 ^{bc}	0.33±0.02 ^{b}	0.25±0.04 ^{a}	0.19±0.03 ^{c}
C/N	6 ^{b} ±0.3	6.3 ^{b} ±0.4	6 ^{b} ±0.5	9.5 ^{a} ±0.6
SOM	1.53 ^{c} ±0.3	**3.62 ^{a} ±0.3**	**2.58 ^{b} ±0.4**	**3.1 ^{a} ±0.8**
FDA	42 ^{a} ±2	46 ^{a} ±2	48 ^{a} ±1	43 ^{a} ±3
DHA	57 ^{c} ±2	**69 ^{a} ±2**	**62 ^{b} ±3**	**64 ^{b} ±1.5**
MBC	835 ^{d} ±18	**1100 ^{b} ±21**	**1180 ^{a} ±34**	**890 ^{c} ±27**
HC	0.60 ^{a} ±0.05	0.44 ^{b} ±0.02	0.65 ^{a} ±0.01	0.60 ^{a} ±0.03
FC	0.45 ^{b} ±0.08	0.22 ^{c} ±0.05	0.60 ^{a} ±0.03	0.58 ^{a} ±0.03
HC/FC	1.33 ^{b} ±0.12	2 ^{a} ±0.10	1.08 ^{c} ±0.04	1.03 ^{c} ±0.06
CSC	18.7 ^{b} ±1.6	**25 ^{a} ±1.5**	**23 ^{ab} ±1.3**	**24 ^{a} ±1**

Compost ID	Waste materials	C/N	BD	WC
C1	90% olive wastes(from three phases olive oil extraction) + 10% straw	$50^{b*}\pm1.9$	$602^{b}\pm5.8$	$73^{c}\pm2.1$
C2	90% wastes (from two phases olive oil extraction) + 10% straw	$60^{a}\pm1.9$	$699^{a}\pm7.4$	$67^{d}\pm1.3$
C3	10% Straw + 80% broadleaf vegetables + 10% manure	$23^{c}\pm1.5$	$533^{c}\pm8.2$	$80^{b}\pm2.4$
C4	10% Straw + 90% broadleaf vegetables	$20^{c}\pm1.4$	$461^{d}\pm6.9$	$87^{a}\pm2.1$

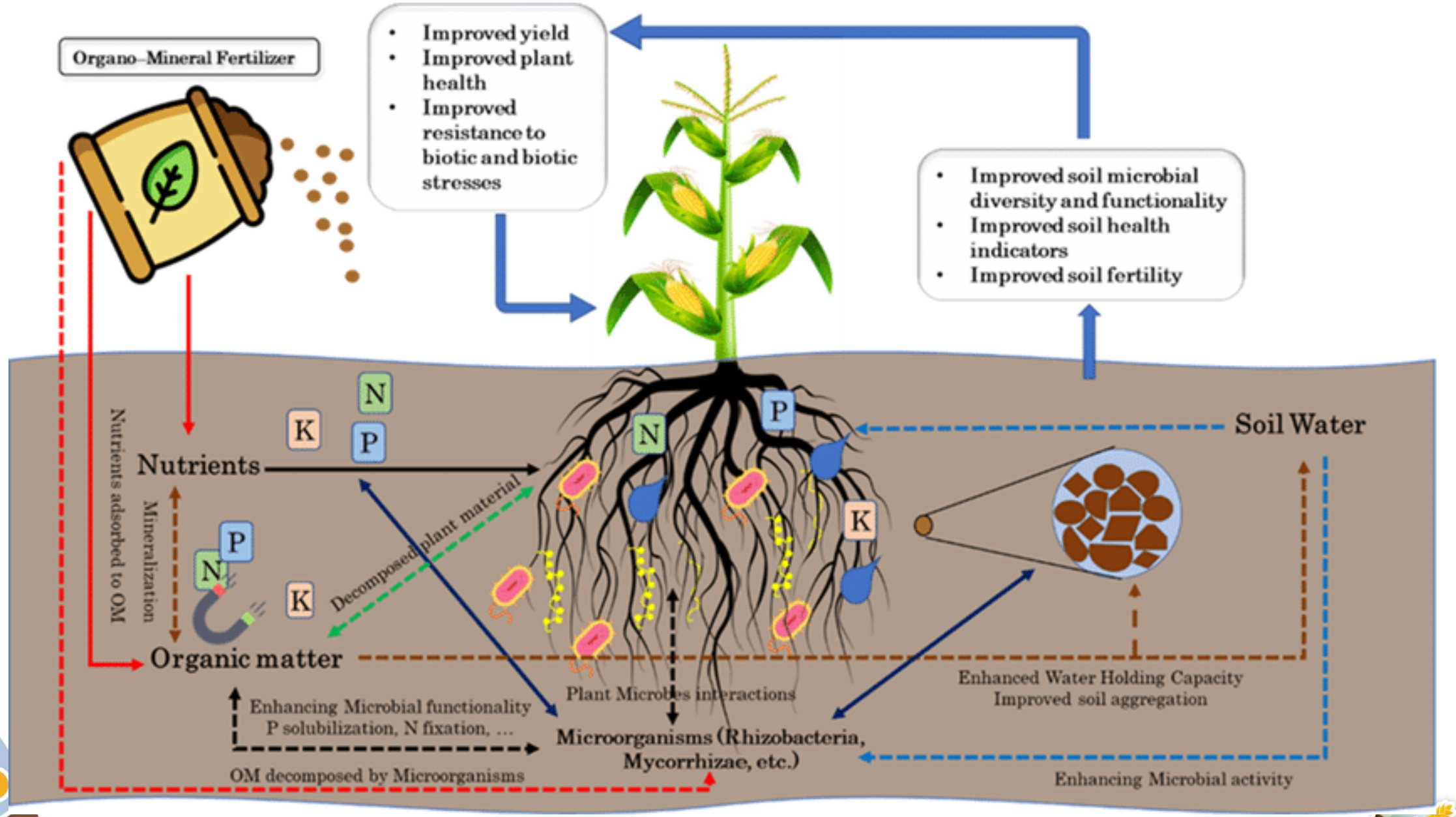
ID	pH	EC	WC	SOM	TN	C/N	WSP
CTR	8.50^{a*}±0.04	350^{e}±8.04	21.4^{c}±1.1	1.5^{c}±0.05	0.15^{c}±0.003	6^{d}±0.06	14^{e}±1.12
S+C1	8.00^{b}±0.05	460^{c}±5.77	**28.40^{a}±0.9**	4.5^{a}±0.23	0.22^{a}±0.002	11.9^{a}±0.01	45^{b}±1.07
S+C2	8.00^{b}±0.08	410^{d}±8.13	**24.50^{b}±1.5**	4.4^{a}±0.21	0.21^{ab}±0.001	12.1^{a}±0.03	50^{a}±1.60
S+C3	8.20^{b}±0.07	1063^{a}±4.23	**24.10^{b}±1.8**	3.5^{b}±0.09	0.21^{ab}±0.002	9.7^{c}±0.01	20^{c}±1.66
S+C4	8.10^{b}±0.0	740^{b}±2.36	**25.50^{b}±1.1**	3.7^{b}±0.12	0.20^{b}±0.003	10.7^{b}±0.03	17^{d}±1.01

ID	MBC	FDA	DHA	BACT	FUN	ACTINOM
CTR	$835^{d*}\pm2.7$	$39.5^{b}\pm0.05$	$57^{b}\pm0.07$	$1.3*10^{5d}\pm0.21$	$4.6*10^{4b}\pm0.53$	$6.7*10^{4d}\pm0.4$
S+C1	**$941^{c}\pm4.31$**	$38.8^{b}\pm0.02$	$59^{b}\pm0.02$	**$1.9*10^{5c}\pm0.19$**	$1.0*10^{5a}\pm1.28$	$1.0*10^{5c}\pm0.2$
S+C2	**$1069^{b}\pm4.5$**	$39.6^{b}\pm0.01$	$61^{b}\pm0.05$	**$2.0*10^{5c}\pm0.13$**	$1.0*10^{5a}\pm0.89$	$1.0*10^{5c}\pm0.2$
S+C3	**$1115^{a}\pm2.99$**	**$62.2^{a}\pm0.13$**	**$69^{a}\pm0.09$**	**$4.0*10^{5b}\pm0.18$**	$2.6*10^{4d}\pm0.04$	$2.3*10^{5a}\pm0.1$

Relevance of Fertilizers Derived from Waste Materia

- **Soil use efficiency increases with the use of organic fertilizers produced from wastes.**

- **All types of by-products resulting from waste transformation processes, irrespective of the waste type, can positively influence soil characteristics by adding nutrients, carbon, and living organisms. This, in turn, helps preserve long-term soil fertility.**



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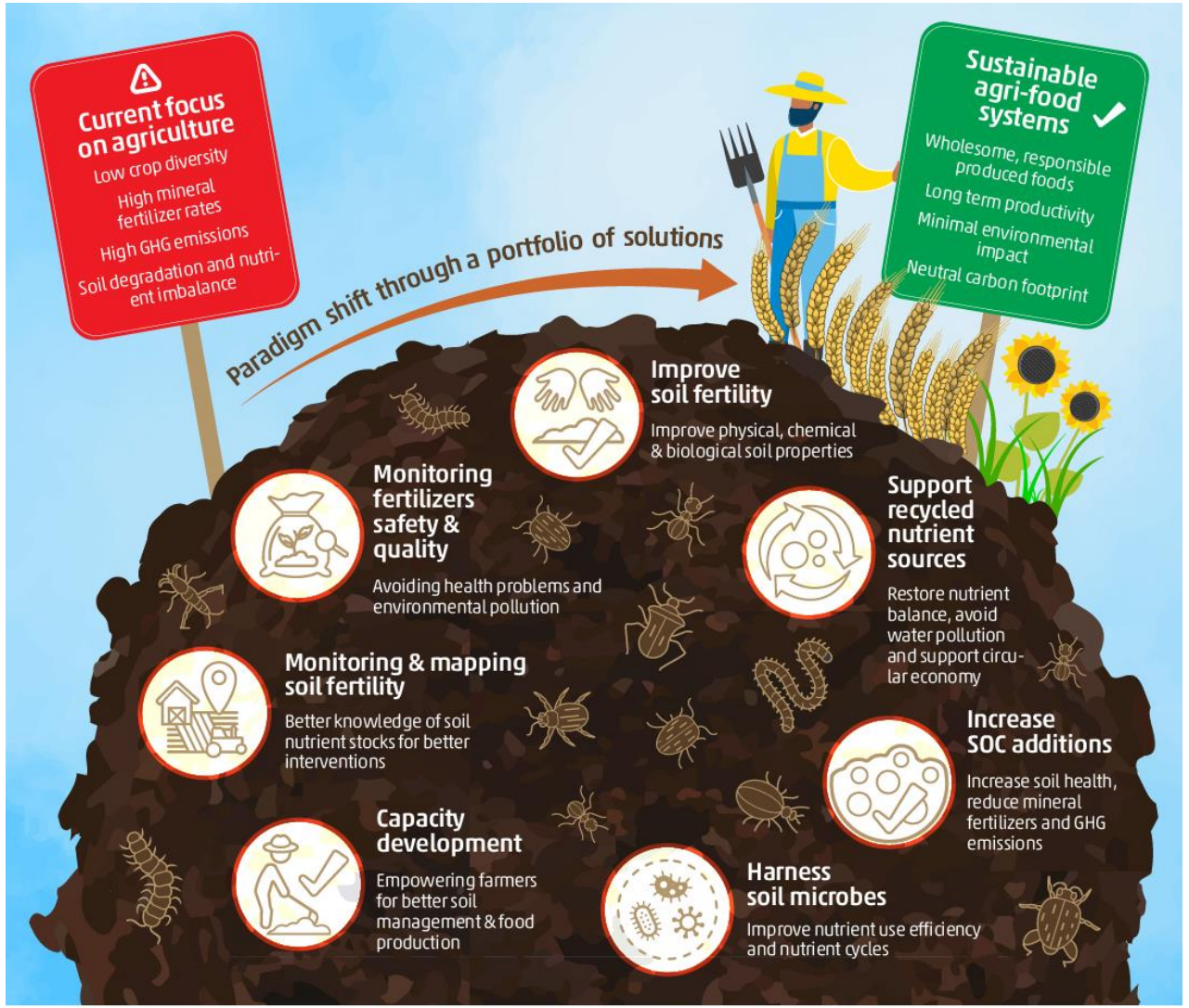

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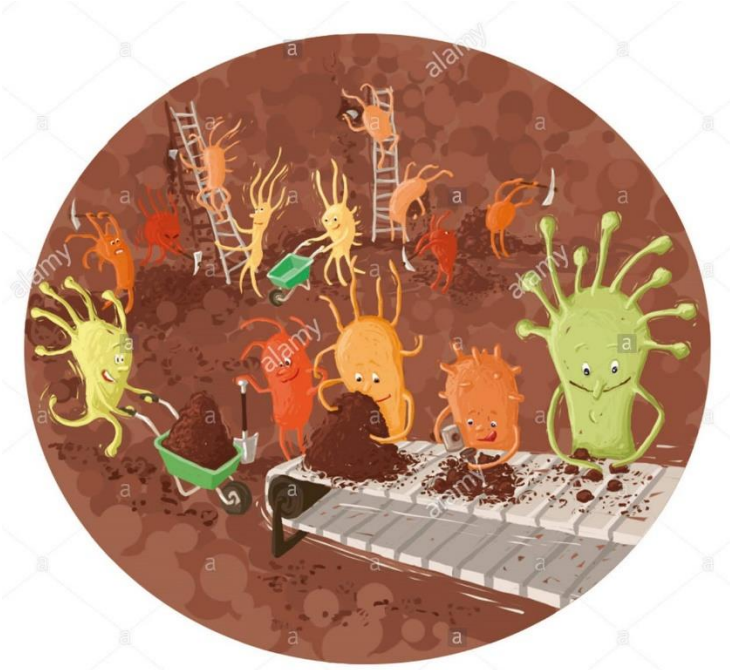
A direct and symbiotic relationship exists between healthy soil and the production of nutritious, high-quality food. By prioritizing soil health, we not only ensure the sustainability of agricultural systems but also contribute to the production of food that promotes human health and well-being.



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