Innovative Fertilization & Application Technologies
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For Yield and Nutrition

Prem Bindraban

Rob Groot, Williams Atakora, William Adzawla,
Amadou Gouzaye, Mohamed El Gharous

ASA/CSSA/SSSA Special Symposium

a virtual private-public partnership session

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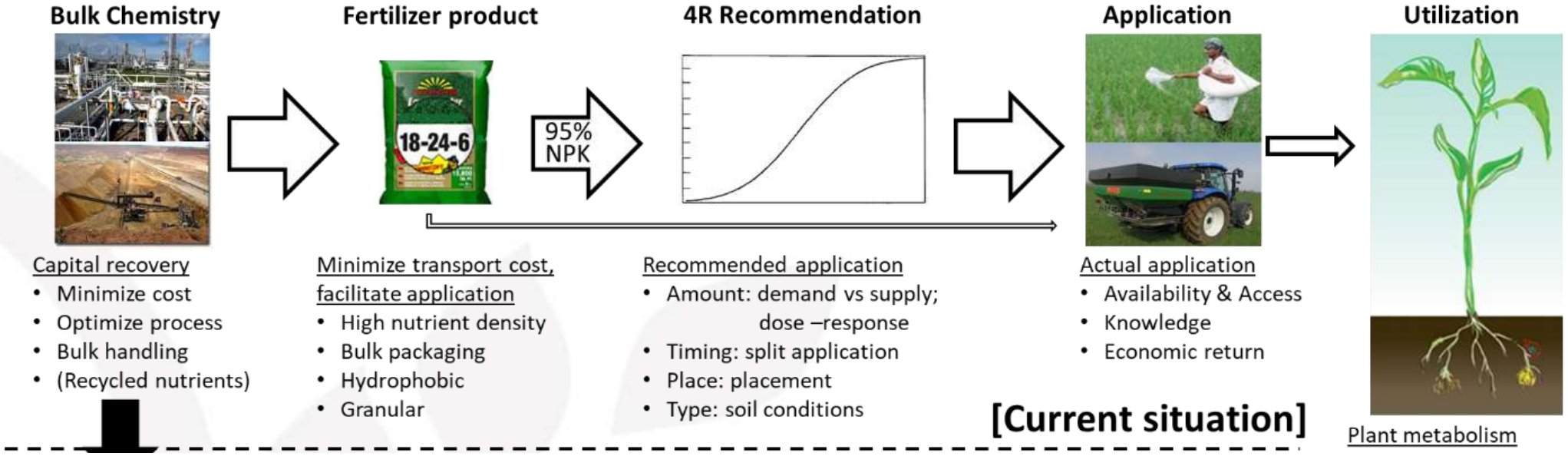
Paradigm shift in fertilizer design



Bindraban, P.S., et al., 2015. Revisiting Fertilisers and Fertilisation Strategies for Improved Nutrient Uptake by Plants. Biol. Fert. Soils 51 (8): 897-911.
Bindraban, P.S., et al., 2020. Safeguarding human and planetary health demands a fertilizer sector transformation. Plants, People, Planet 2 (4): 302-309.

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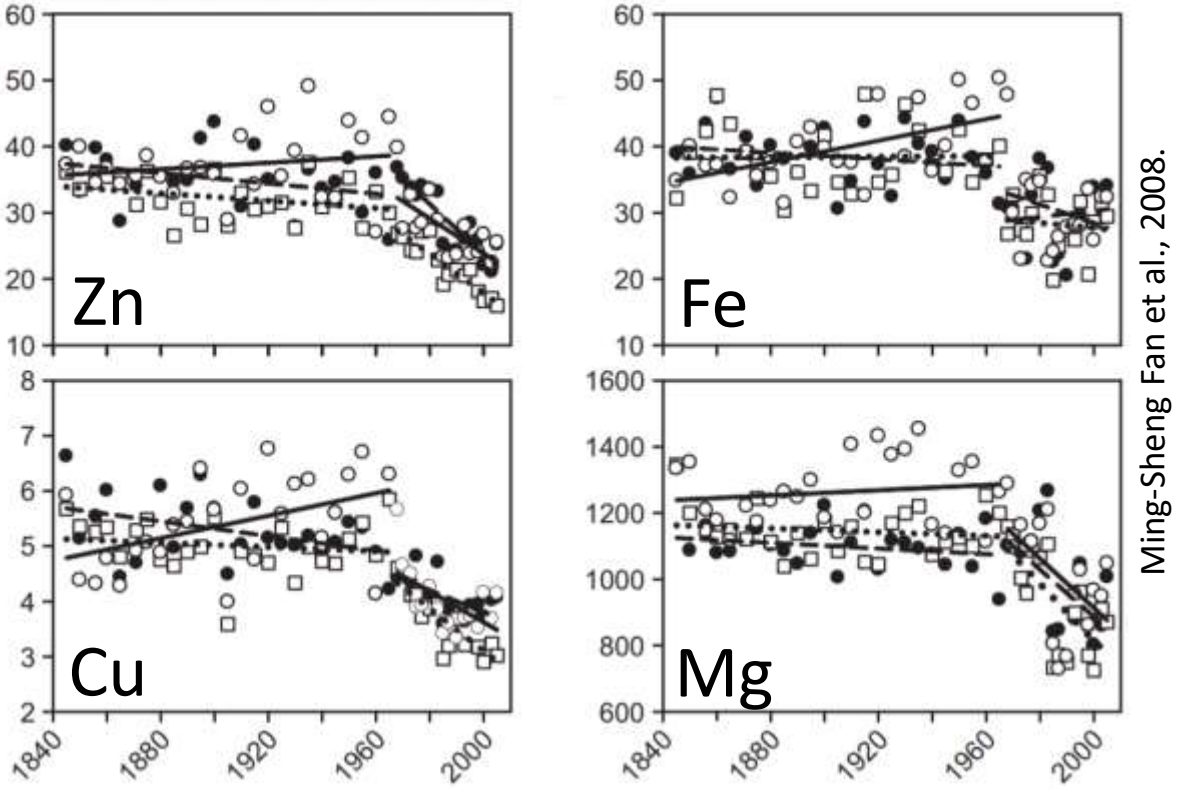
Nutritional quality decline over past decades

Wheat grain nutrients content (mg/kg)



Ming-Sheng Fan et al., 2008.

- Breeding
- Soil mining micronutrients
- Atmospheric CO_2 increase

Zn deficiency

Agronomic Fortification

Dimkpa, C., Bindraban, P.S., 2016. Micronutrients fortification for efficient agronomic production. Agron. Sust. Dev. 36:1-26.

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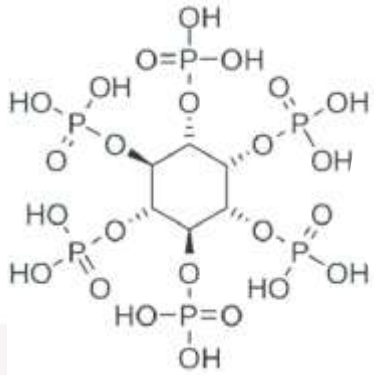
High P (phytate) invigorate malnutrition by Zn, Fe, …,

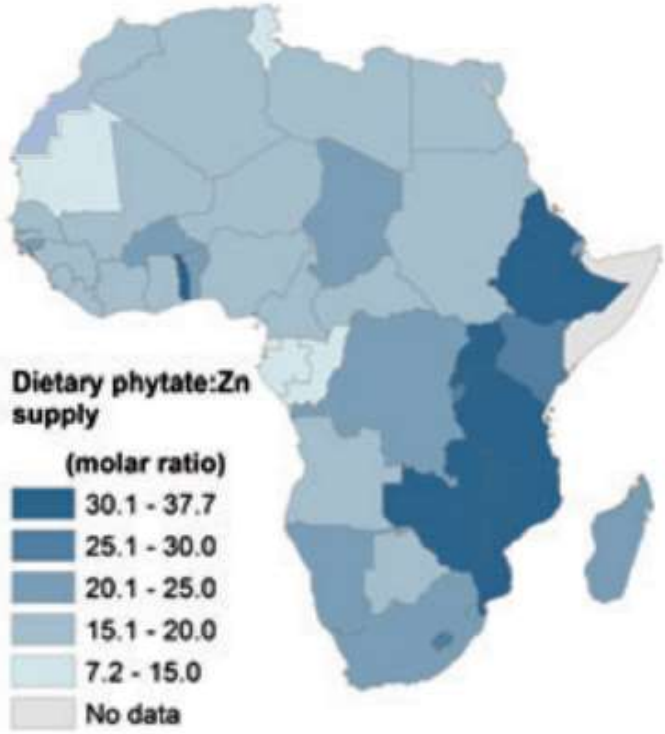
Positive health effects phytate

- anticarcinogen
- strong antioxidant
- inhibitor kidney stone formation



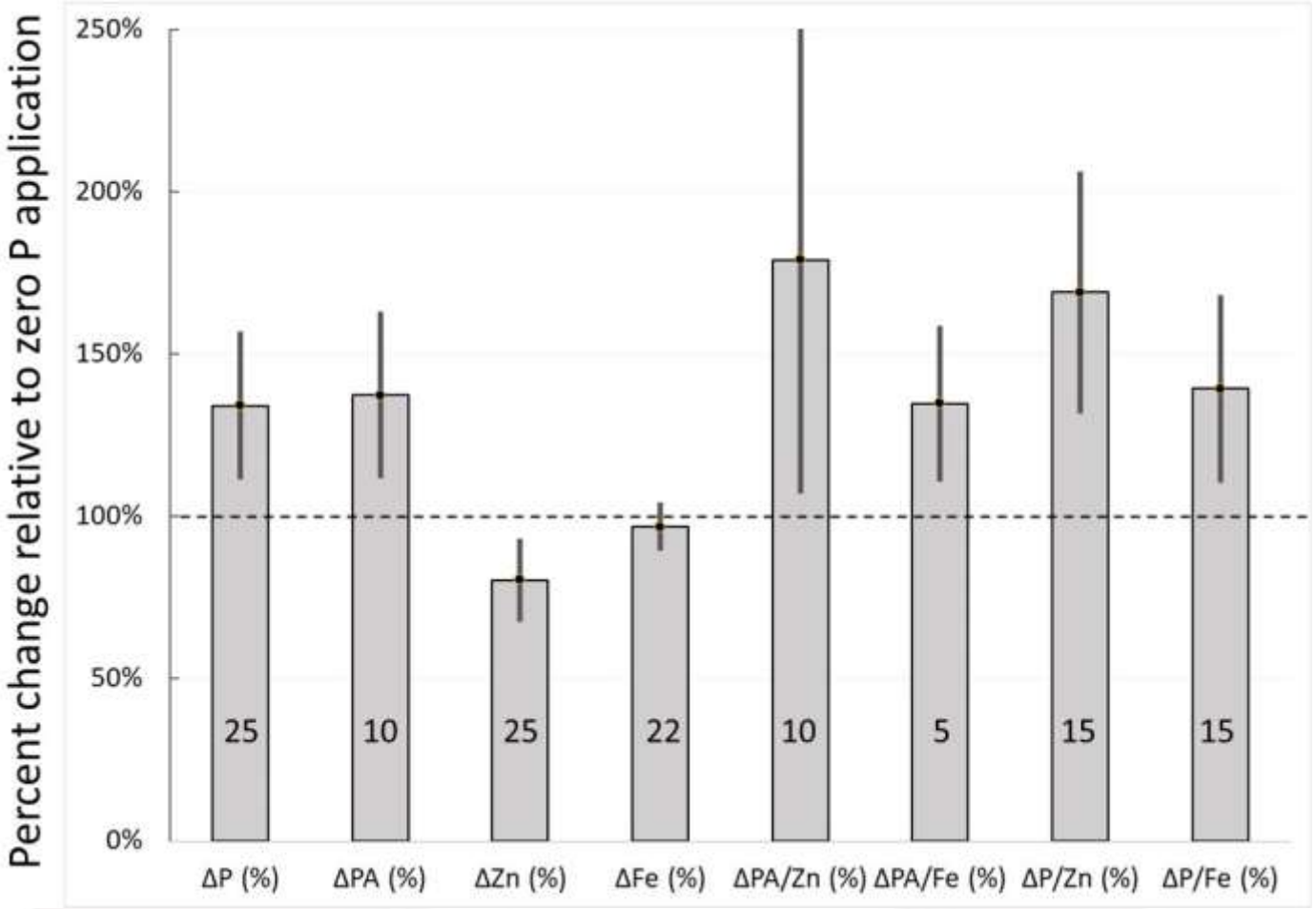
Zn absorption by humans:

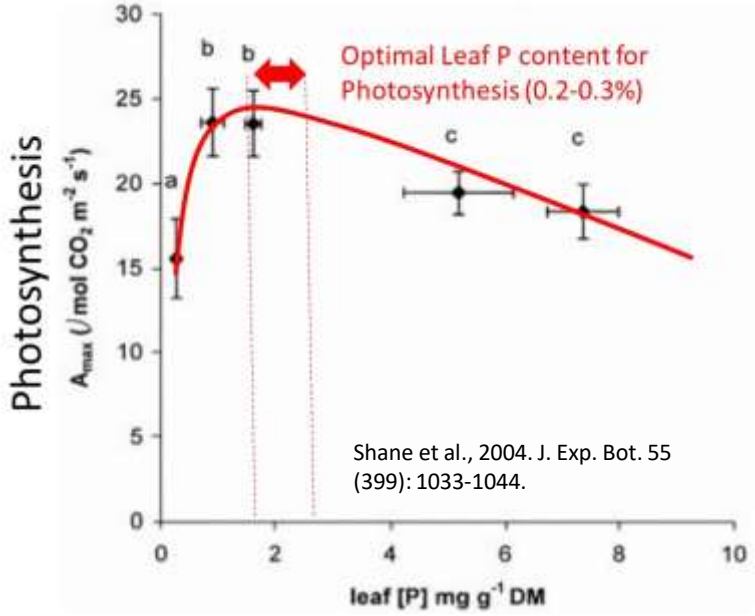
- 50% at PA/Zn molar ratio < 5;
- 30–35% 5–15;
- 15% > 15;
- < 10% 25 or higher



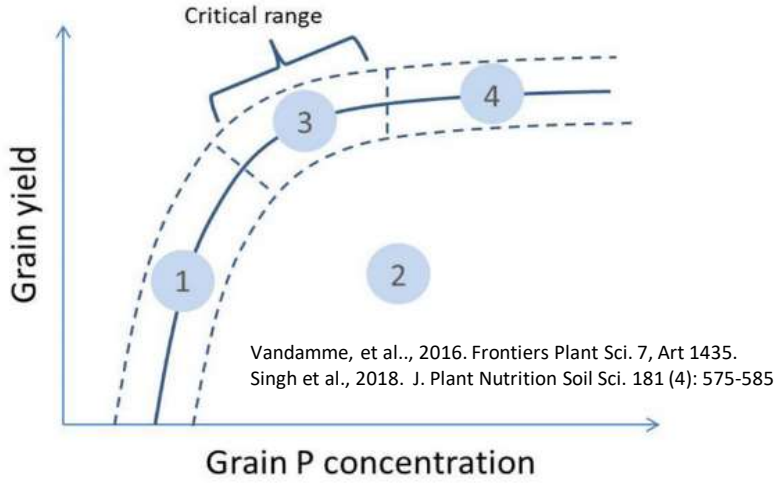
Konietzny, U., Greiner, R., 2003. Phytic acid: Properties and Determination. Encyclopedia of Food Sciences and Nutrition.
Joy et al., 2014. Physiologia Plantarum, 151:208–229. WHO (1996)

Impact of P (fertilization) on Zn and Fe





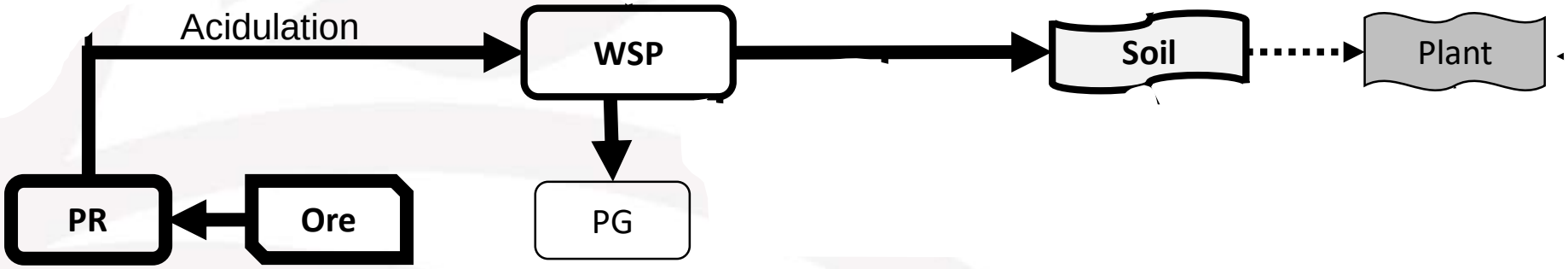
Shane et al., 2004. J. Exp. Bot. 55 (399): 1033-1044.



Vandamme, et al.., 2016. Frontiers Plant Sci. 7, Art 1435.
Singh et al., 2018. J. Plant Nutrition Soil Sci. 181 (4): 575-585

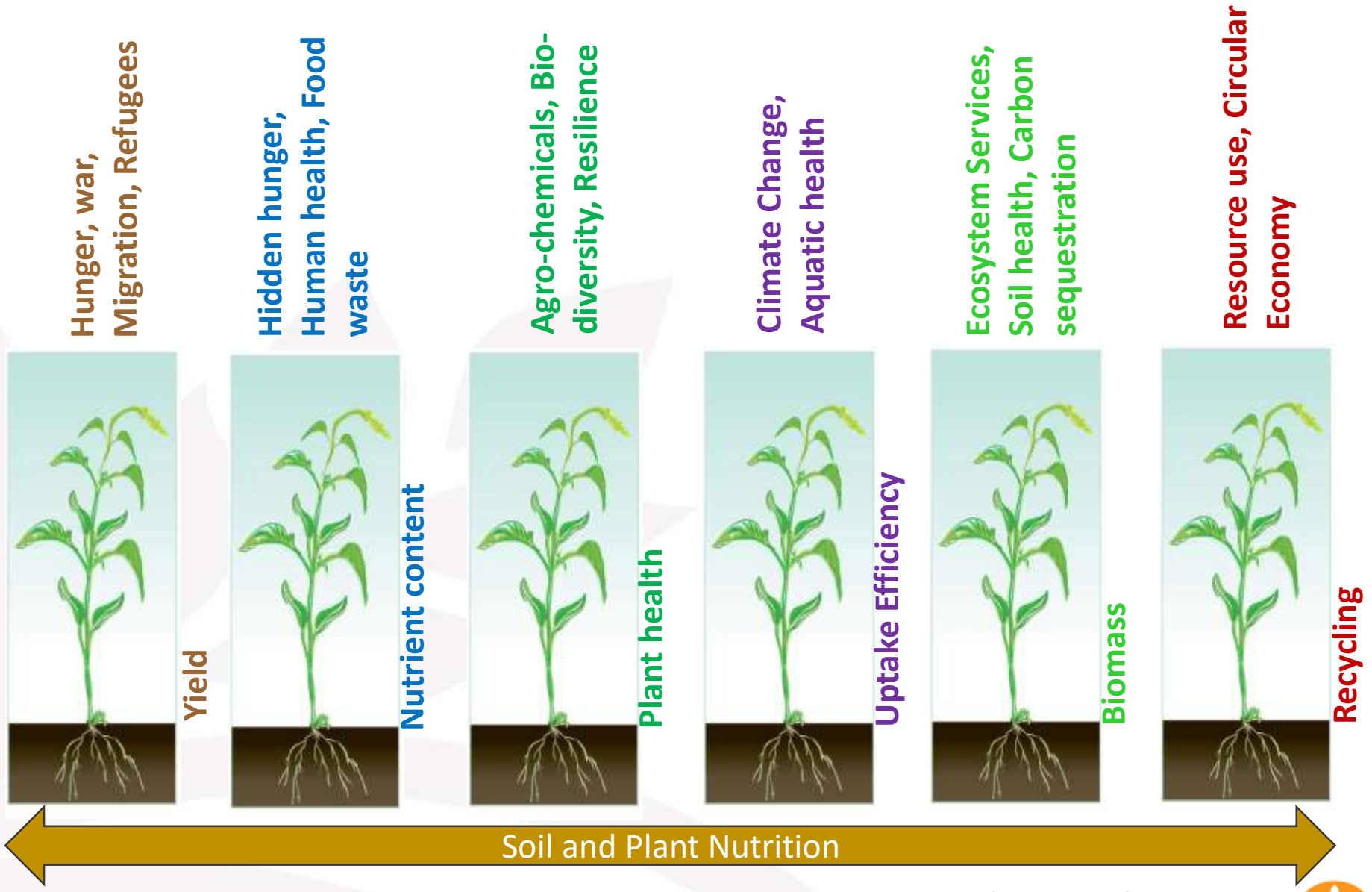
Bindraban, P.S., Dimkpa, C.O., Pandey, R., 2020. Exploring phosphorus fertilizers and fertilization strategies for improved human and environmental health. Biol. Fert. Soils 56: 299–317.

P Fertilizer Development



Bindraban, P.S., Dimkpa, C.O., Pandey, R., 2020. Exploring phosphorus fertilizers and fertilization strategies for improved human and environmental health. Biol. Fert. Soils 56: 299–317.

Fertilizers: from commodity only to public good



Bindraban, P.S., Dimkpa, C., Angle, S., Rabbinge, R., 2018. Unlocking the multiple public good services from balanced fertilizers. Food Security 10: 273–285.

FERARI *Science-based implementation and government support for impact at scale*

IMPACT THROUGHOUT GHANA: MODEL FOR SUB-SAHARA AFRICA

GoG programs allows to reach scale

Policy recommendations and Government engagement

On-station, on-farm, farmer managed trials

Engage small-scale farmers Socio-economic surveys

Capacity strengthening 7 Universities + 2 Research institutes in Ghana

Formal education >50 MSc's, 5 PhD's, 2 Post-Docs

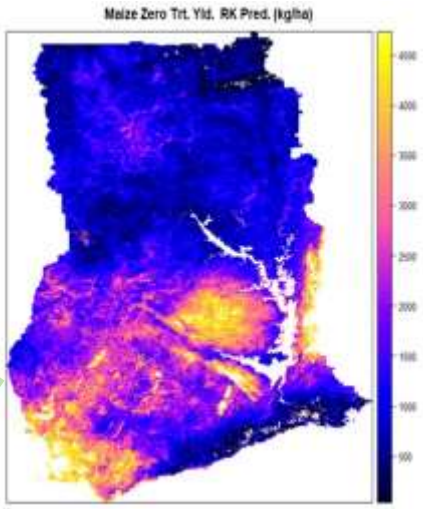
Improve Food and Nutrition Security

Sustainable Agricultural Intensification

Fertilizer Sector Transformation

Fertilizer value chain prepared

Fertilizer recommendations



Develop crop-soil specific fertilizer recommendations

Ghana Fertilizer Platform

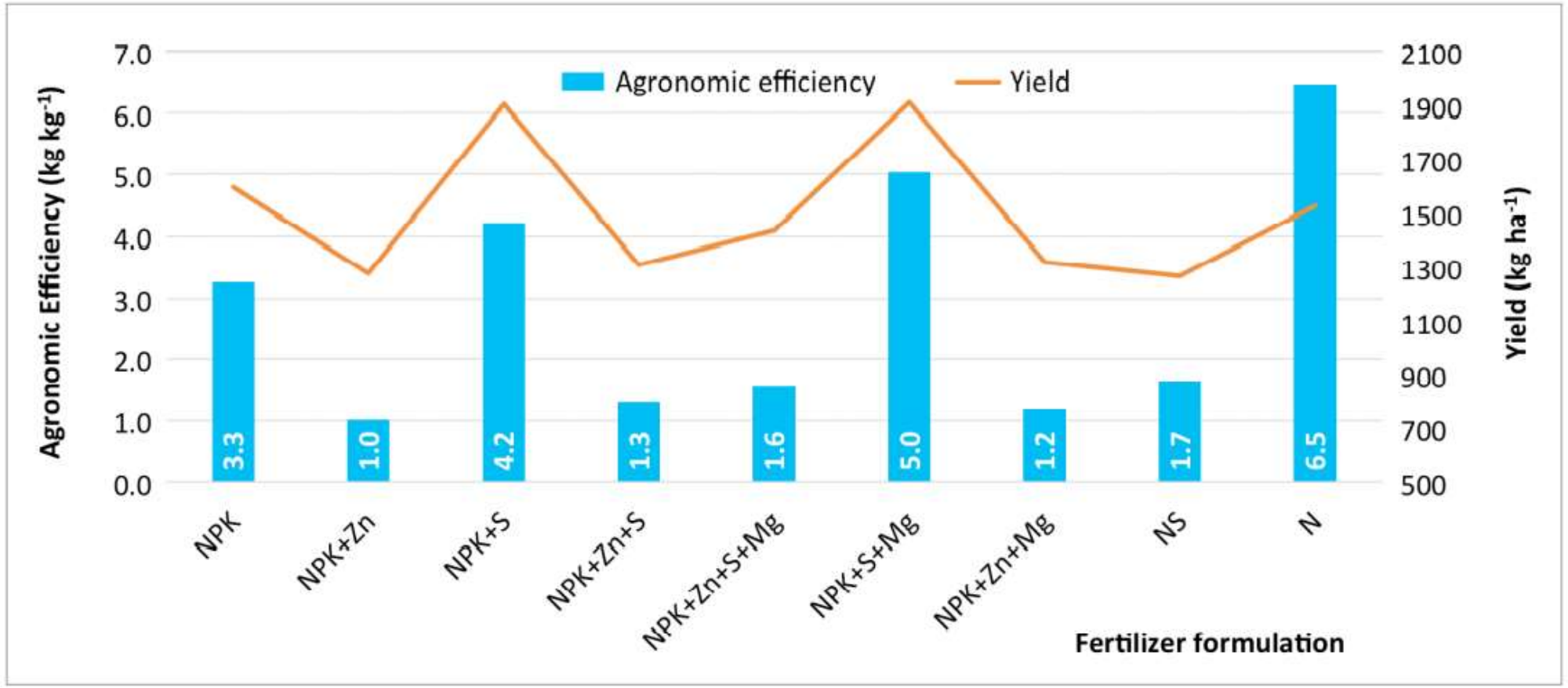
Catalyze stakeholder dialogues to optimize fertilizer value chain

Government of Ghana's Program Planting for Food and Jobs

FERARI ENTRY POINT

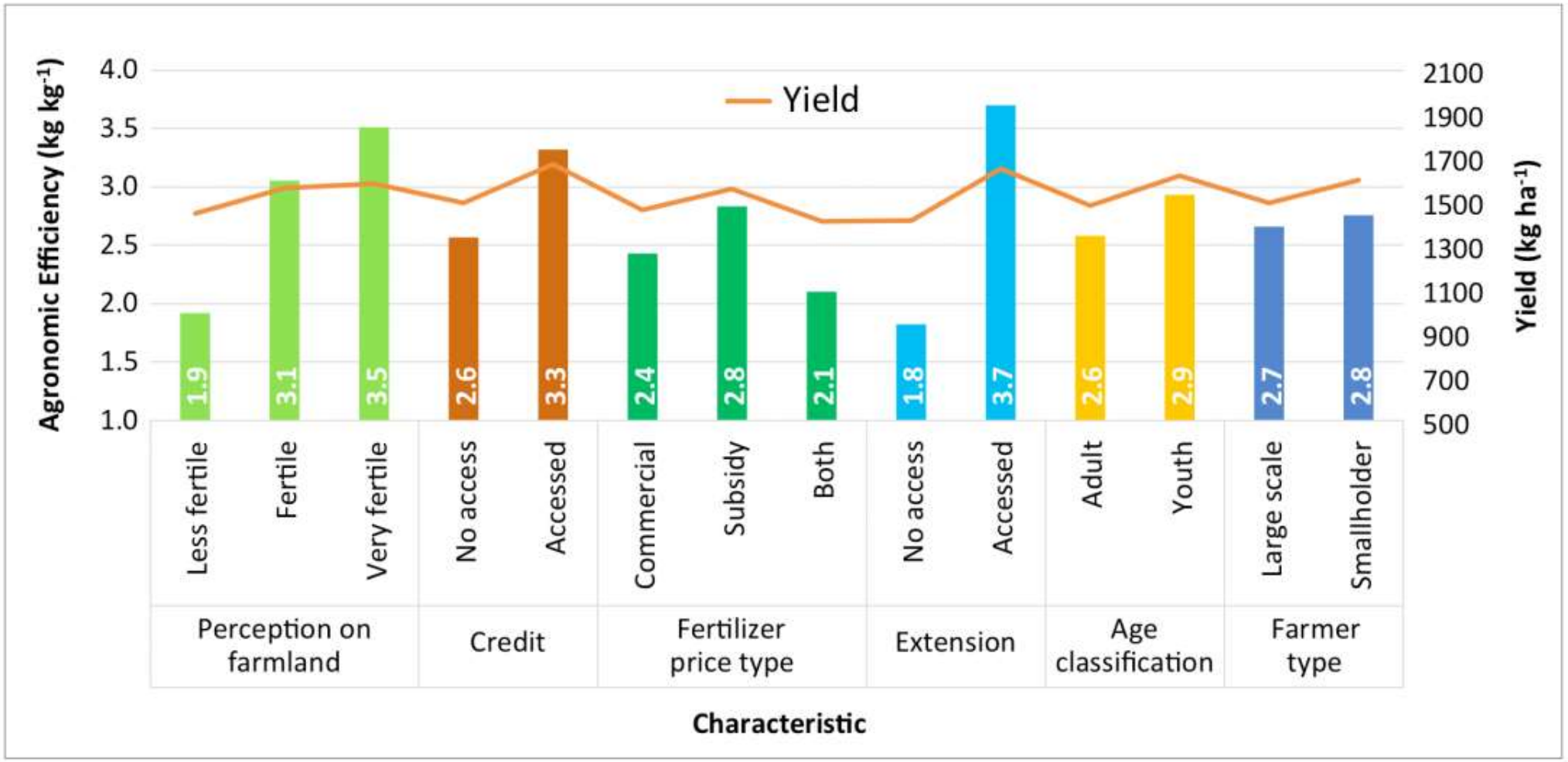
On-station - on-farm - farmer managed

Agronomic Use Efficiency – Fertilizer products



30-50 kg grain/kg N

Agronomic Use Efficiency - Management



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Thank You

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