Do we really need fertilizers to grow healthy crops?

Fusuo Zhang
China Agricultural University

SOILS: WHERE FOOD BEGINS

Global Symposium on Soils for Nutrition | 26-29 July 2022

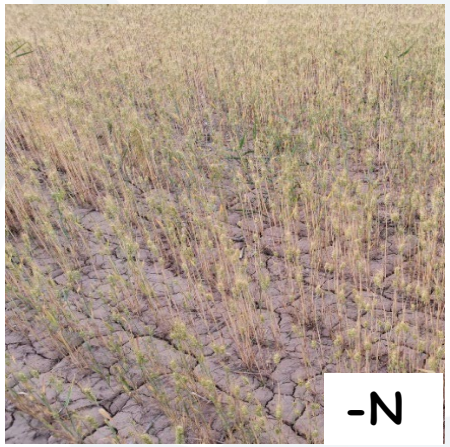
GLOBAL SOIL PARTNERSHIP

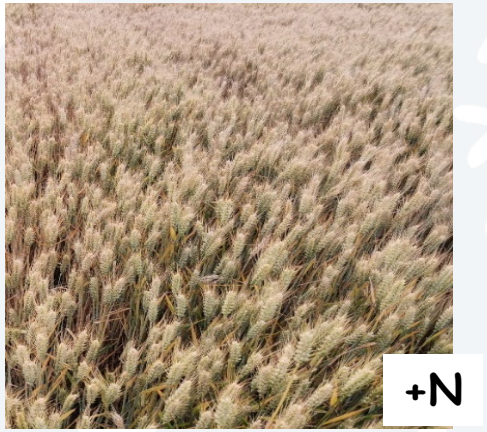
Outline

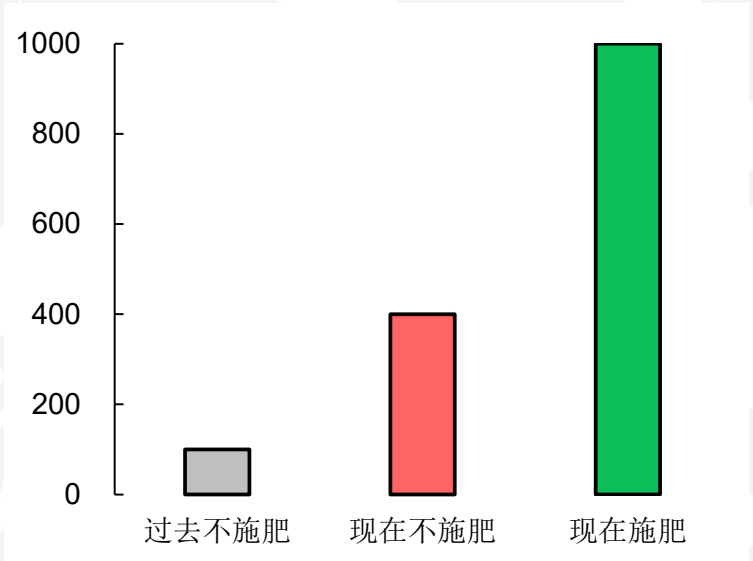
- No fertilizers, no crop health and food security
- Optimizing nutrient management for high crop yield/quality while minimizing environmental impacts
- Work with smallholder farmers for knowledge transfer

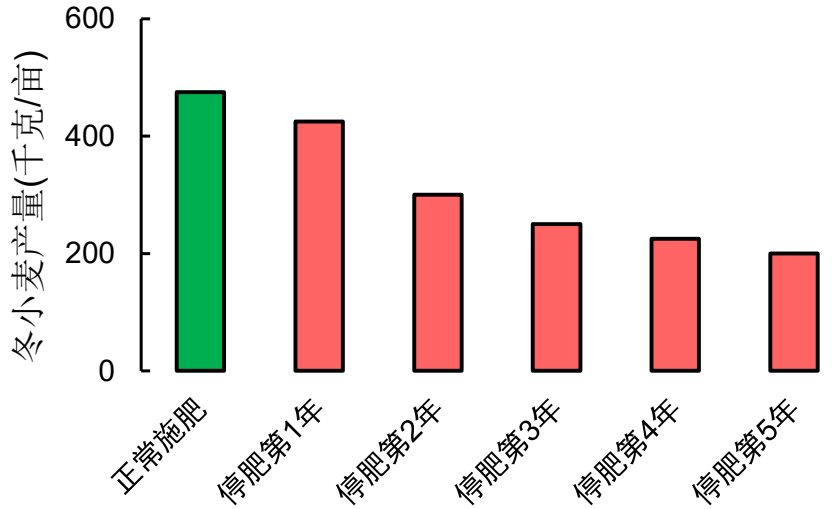
NO soils could meet nutrient demand of crops in time, space and quantity

Soil only provide 1/3 nitrogen required for high yield in winter wheat production



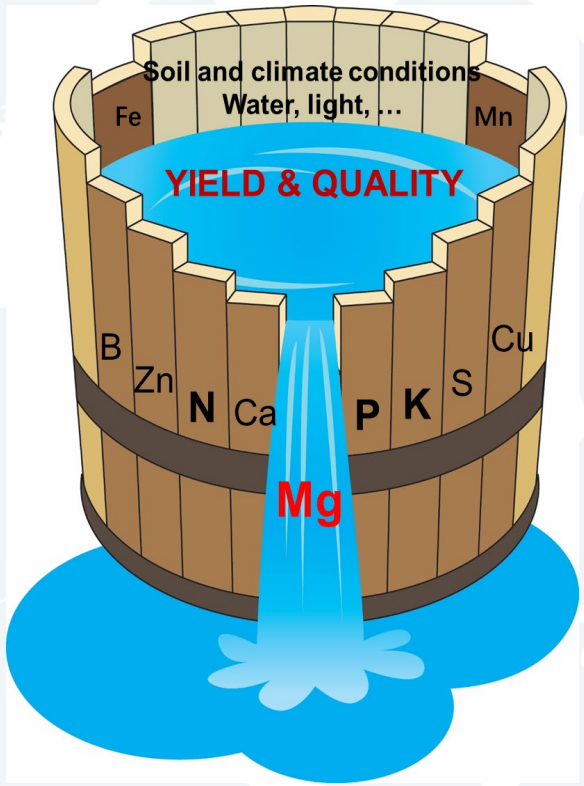




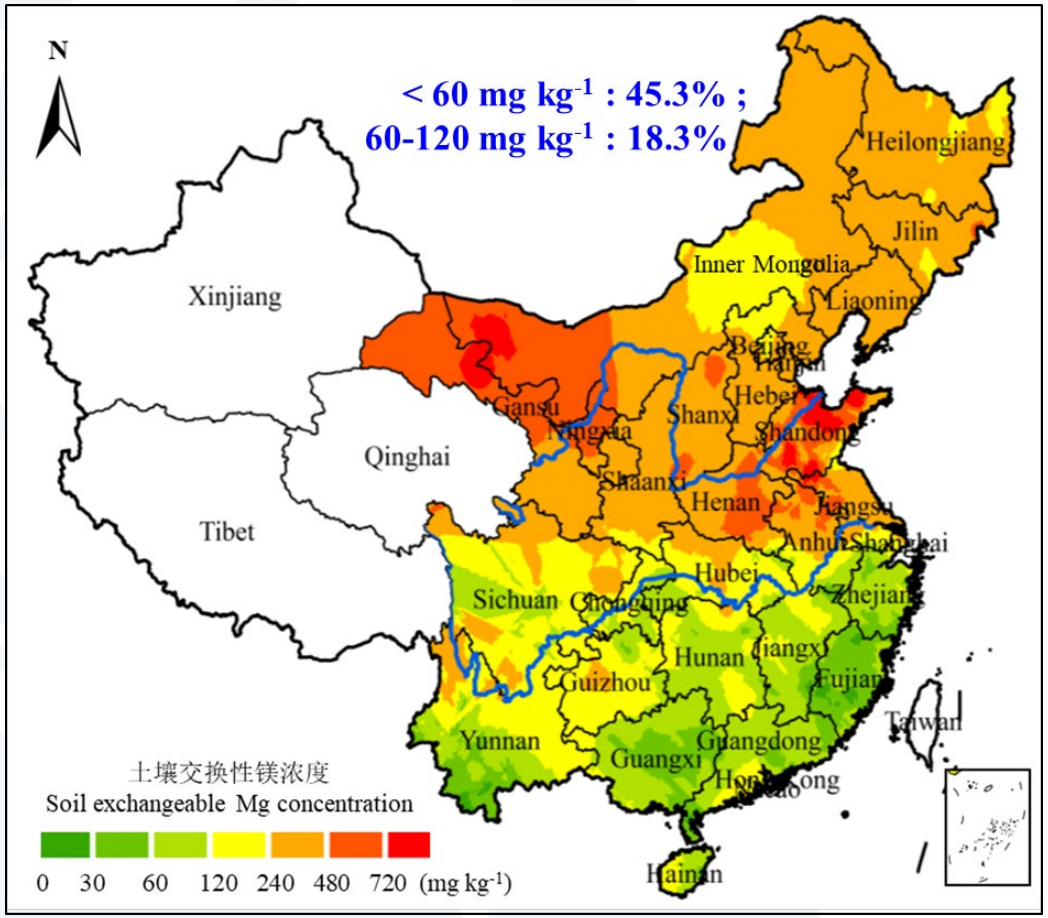


Quzhou, Hebei

Without Mg fertilizer, crop health and yield will be affected



widespread low Mg soils



+Mg and - Mg

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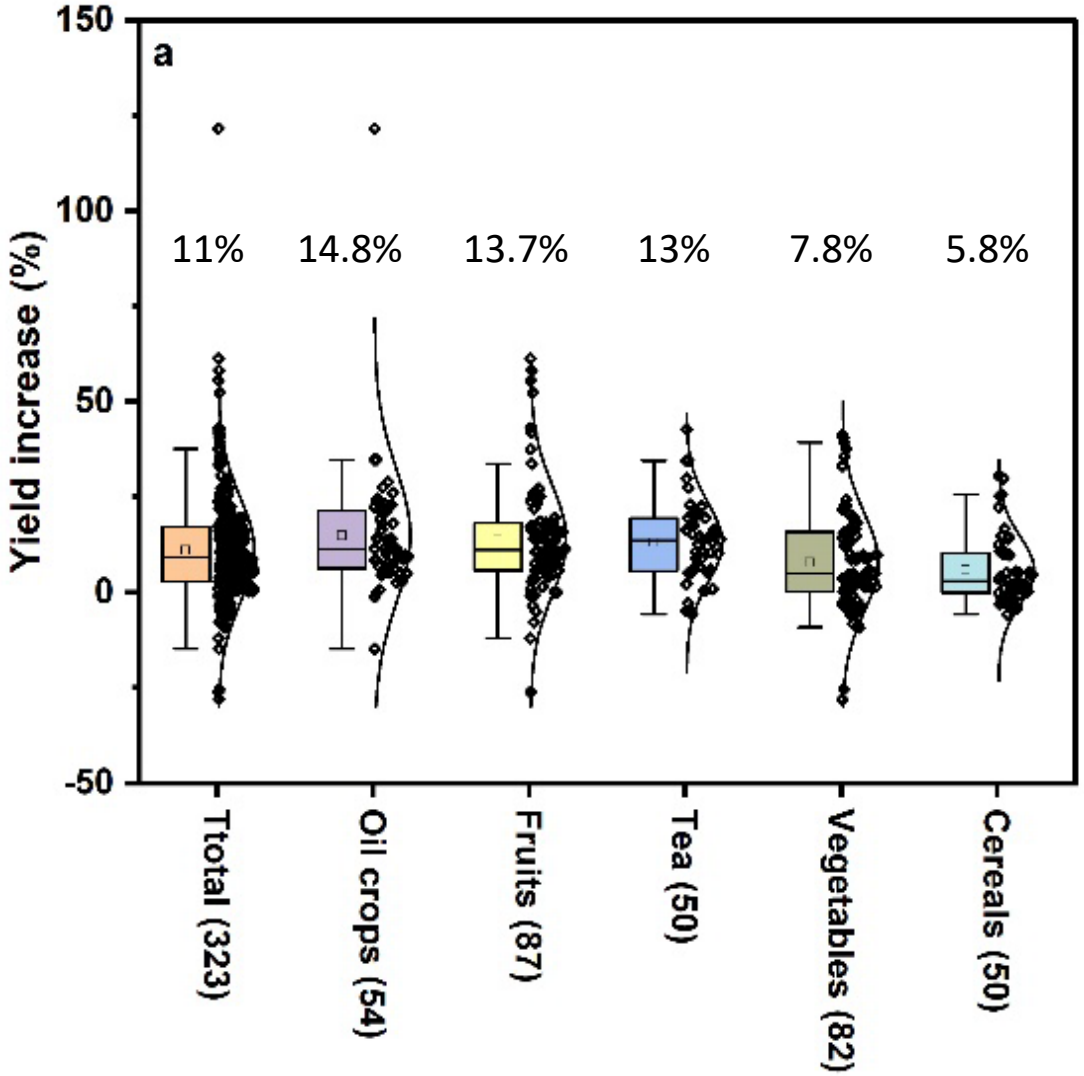
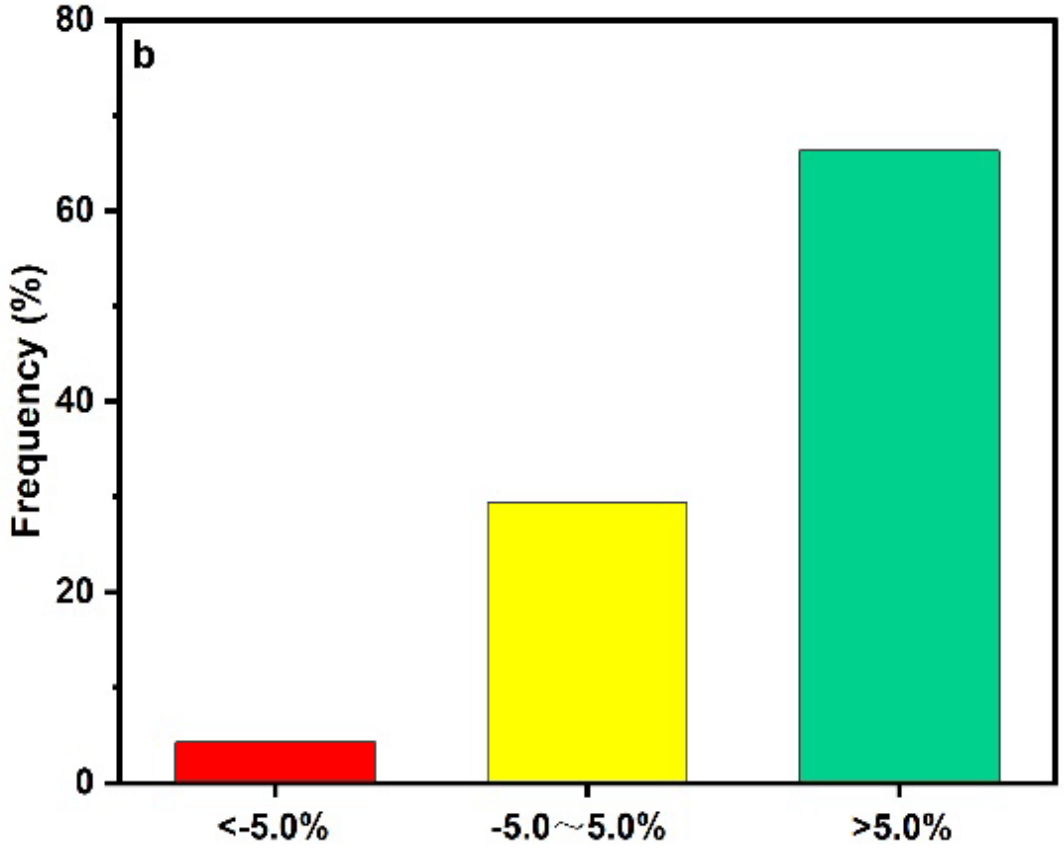
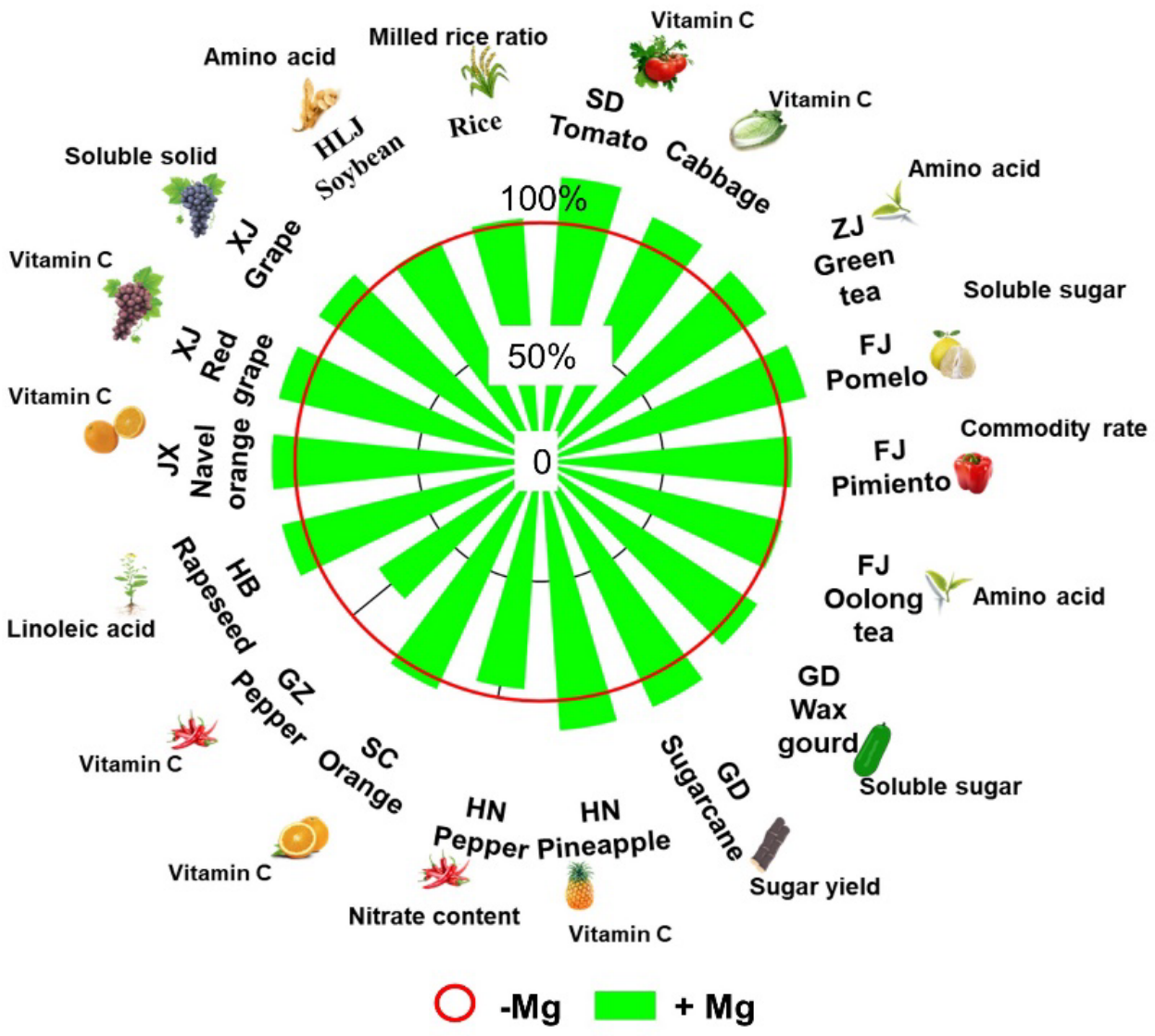
Effects of Mg supplies on crops yield (a) and the frequency distribution of different yield increment (b)

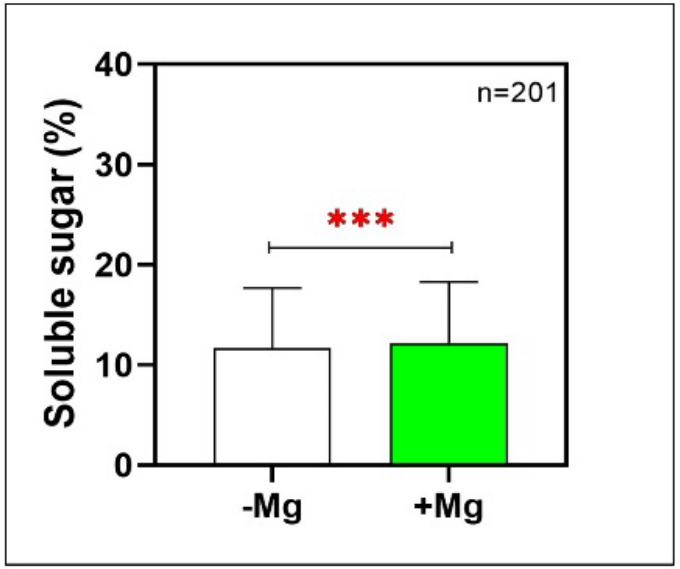


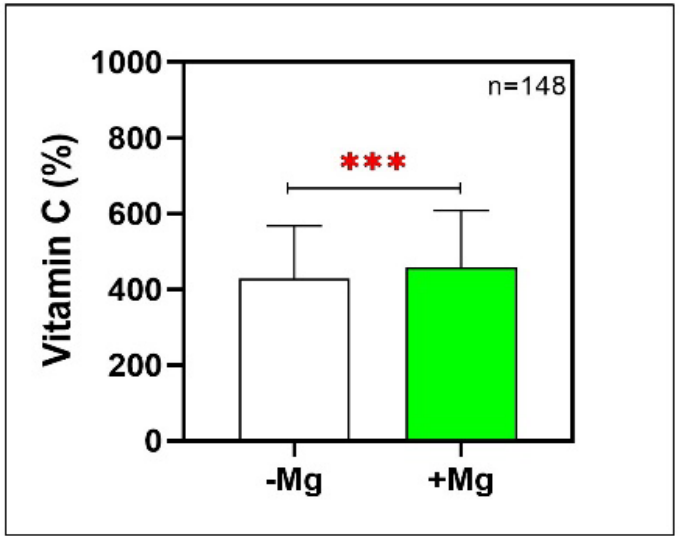


IMI

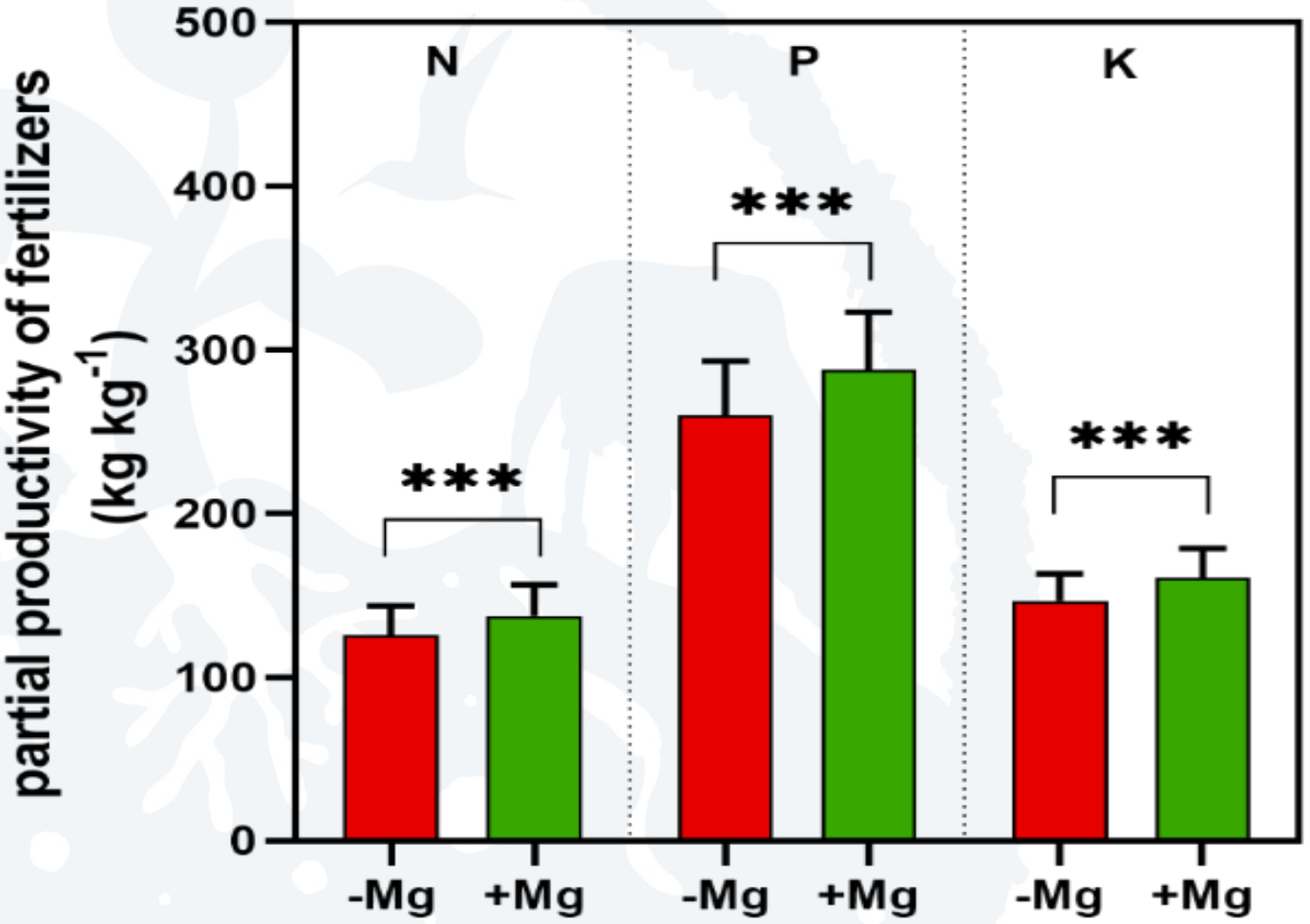
Effects of Mg supplement on the quality of crops



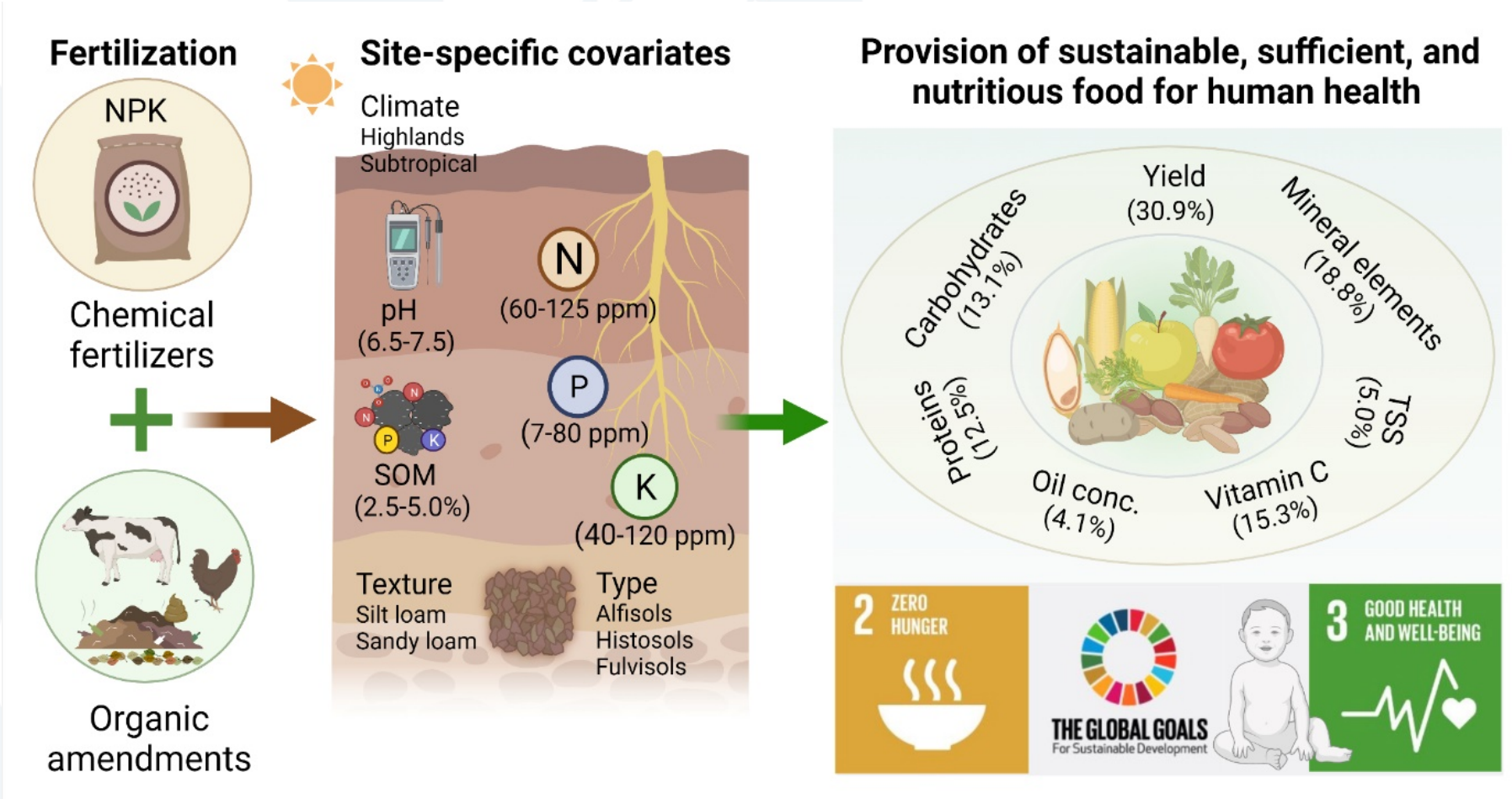




Effects of Mg application on fertilizer efficiencies in term of partial productivity(PFP)



Sufficient and balanced nutrient provision is crucial for improvement of crop production and human health



Ishfaq et al., unpublished

Outline

- No fertilizers, no crop health and food security
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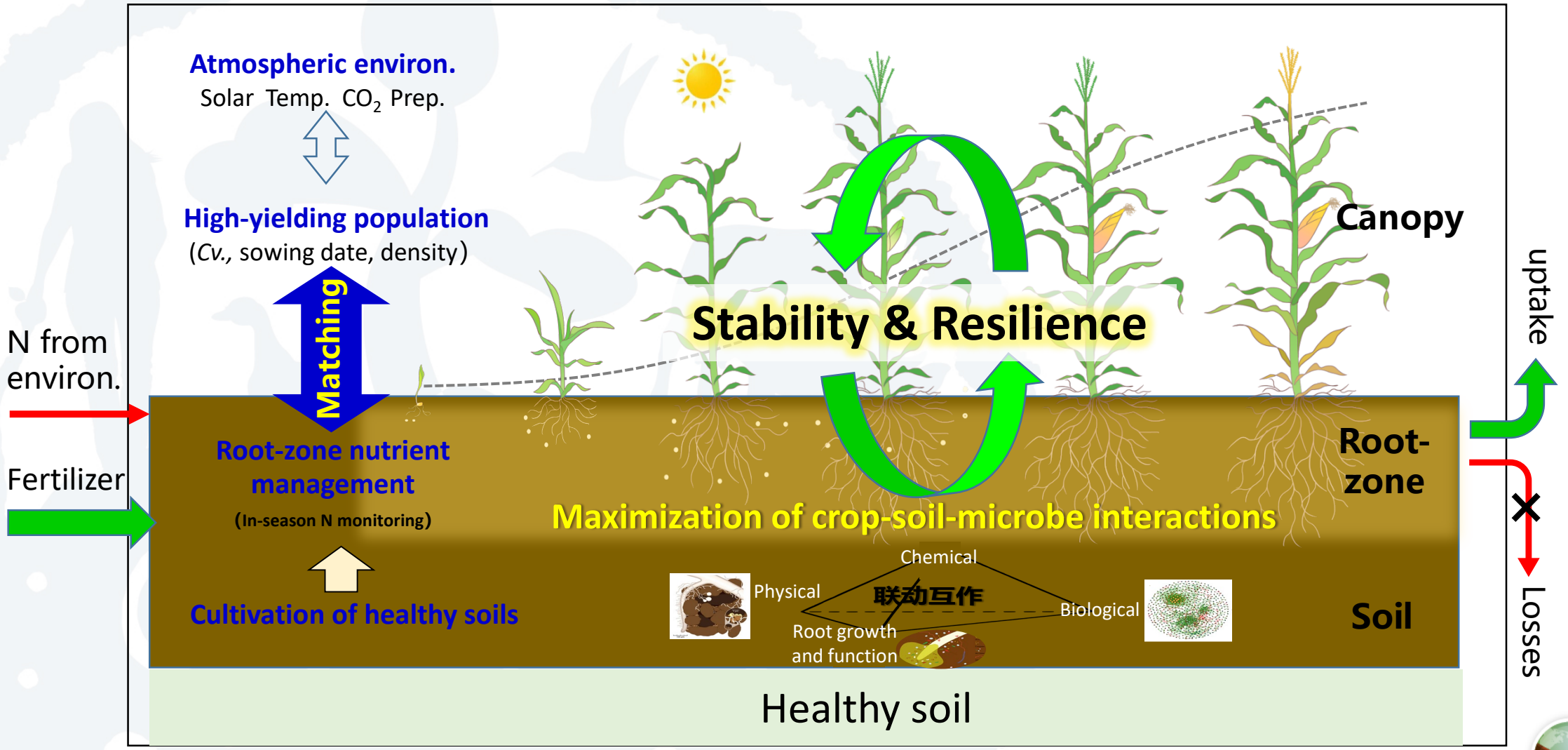
The principle and comprehensive approach of nutrient management: Integrated Soil-crop System Management (ISSM)



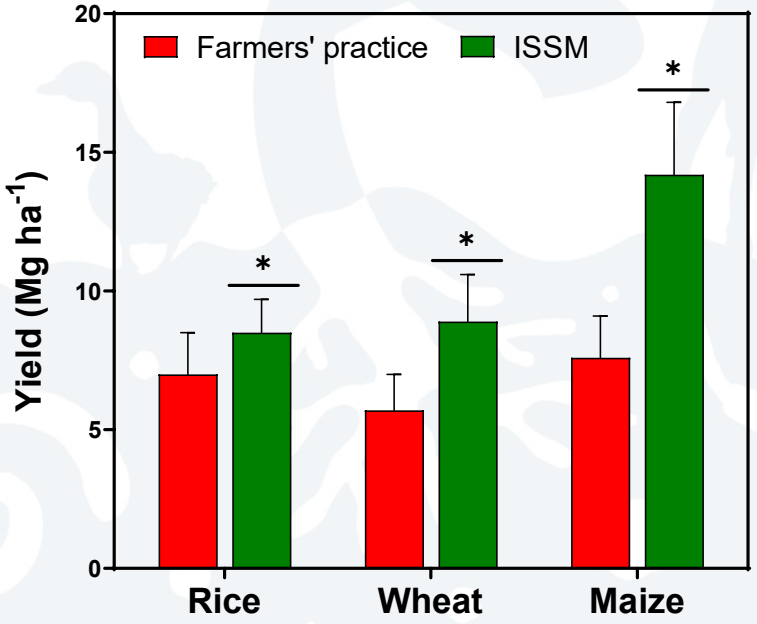
LETTER

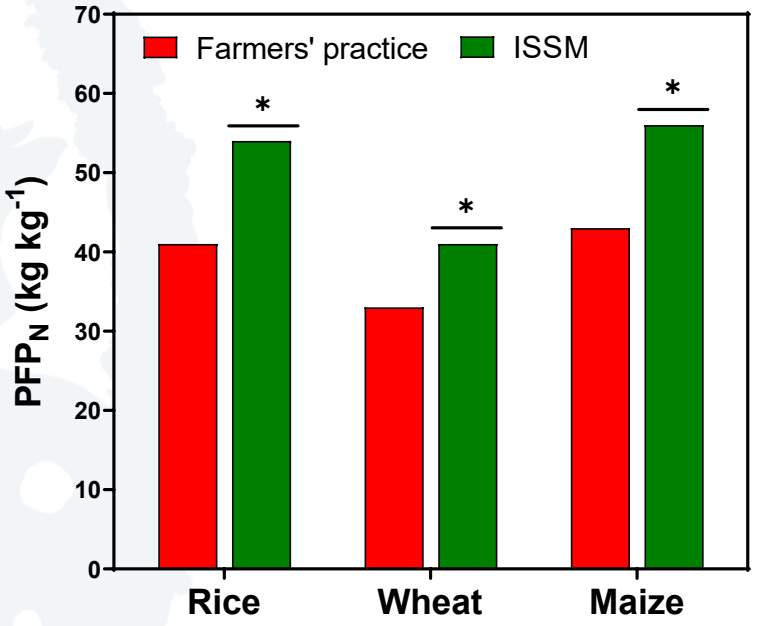
doi:10.1038/nature13609

Producing more grain with lower environmental costs

Xinping Chen[1]*, Zhenling Cui[1]*, Mingsheng Fan[1], Peter Vitousek[2], Ming Zhao[3], Wenqi Ma[4], Zhenlin Wang[5], Weijian Zhang[3], Xiaoyuan Yan[6], Jianchang Yang[7], Xiping Deng[8], Qiang Gao[9], Qiang Zhang[10], Shiwei Guo[11], Jun Ren[12], Shiqing Li[8], Youliang Ye[13], Zhaohui Wang[14], Jianliang Huang[15], Qiyuan Tang[16], Yixiang Sun[17], Xianlong Peng[18], Jiwang Zhang[5], Mingrong He[5], Yunji Zhu[13], Jiquan Xue[14], Guiliang Wang[1], Liang Wu[1], Ning An[1], Liangquan Wu[1], Lin Ma[1], Weifeng Zhang[1] & Fusuo Zhang[1]

Integrated soil-crop system management (ISSM) increases crop yield and NUE by 30-50%





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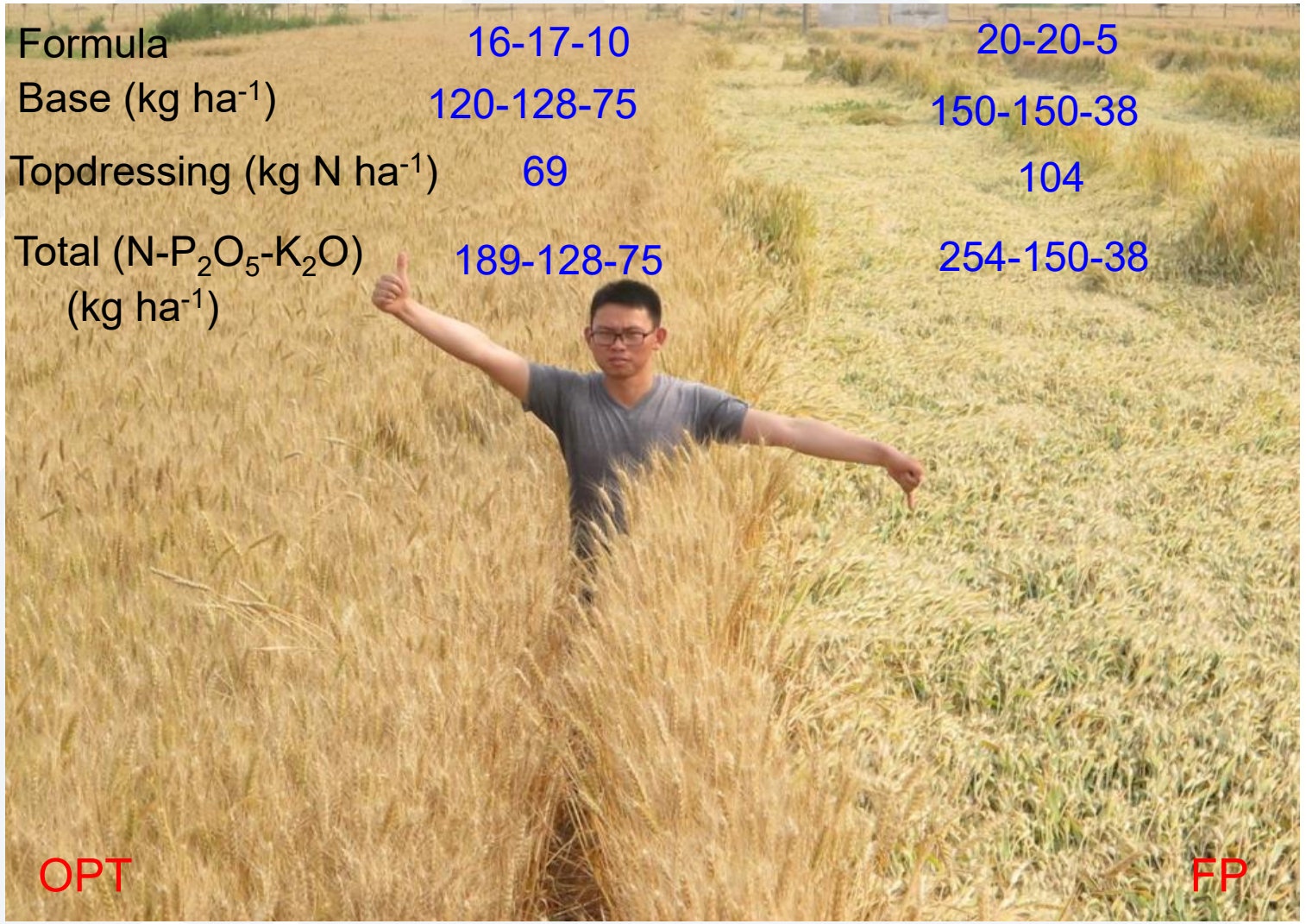
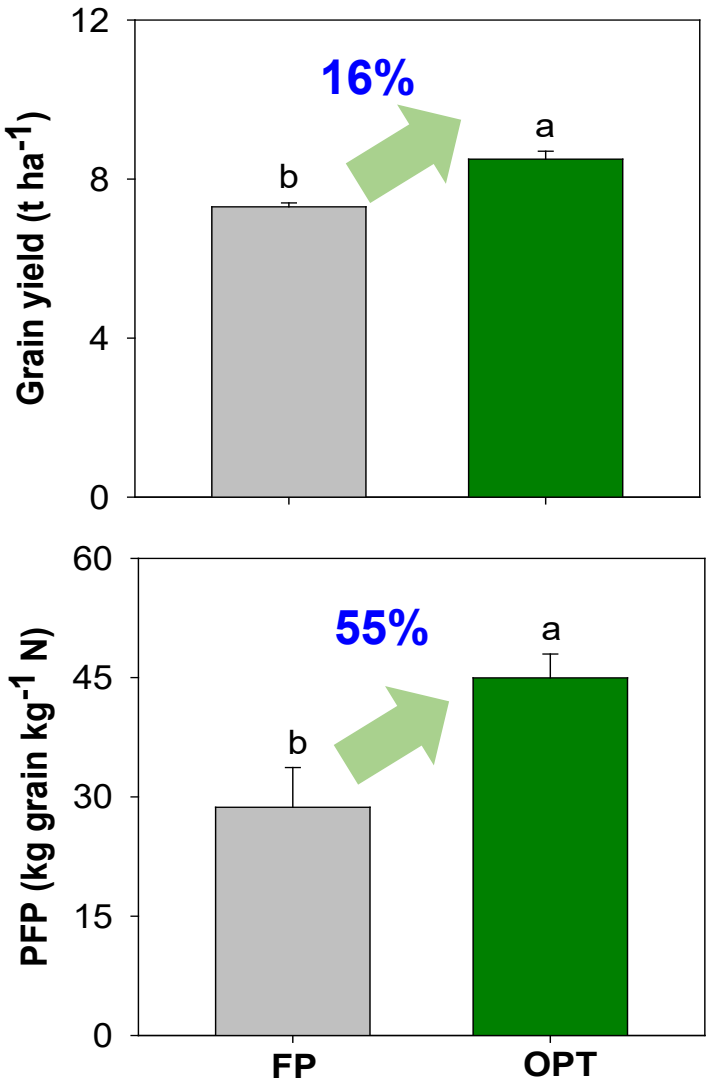
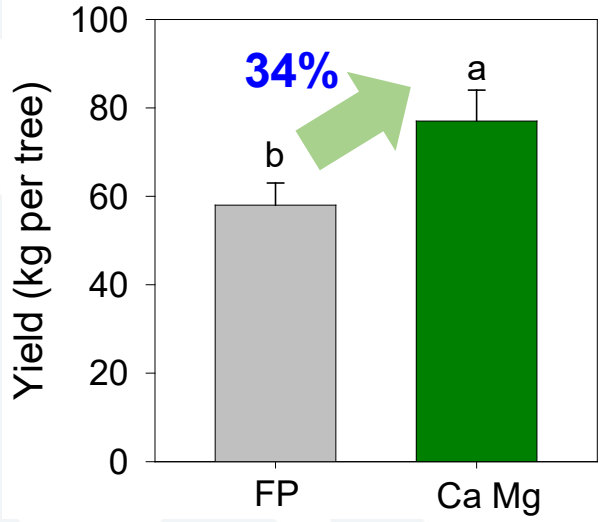
Balanced nutrition results in high crop yield and NUE

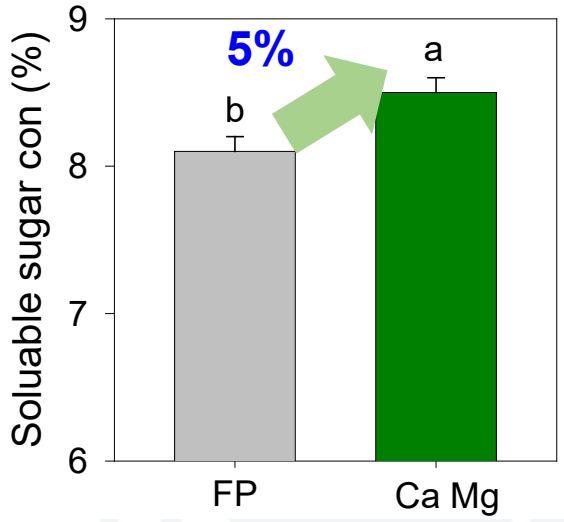


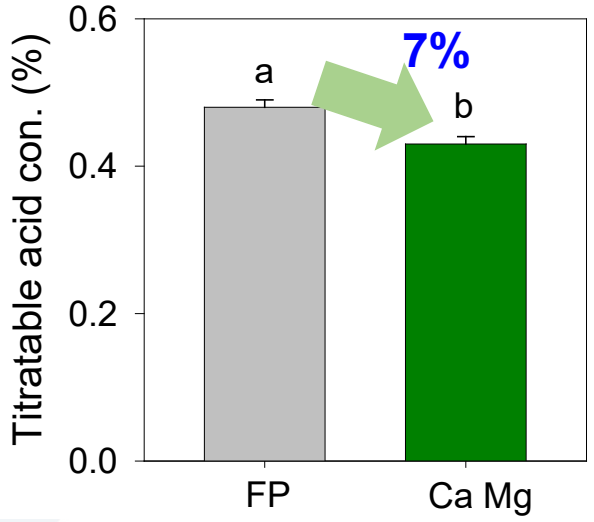


(Farmer survey in Quzhou)

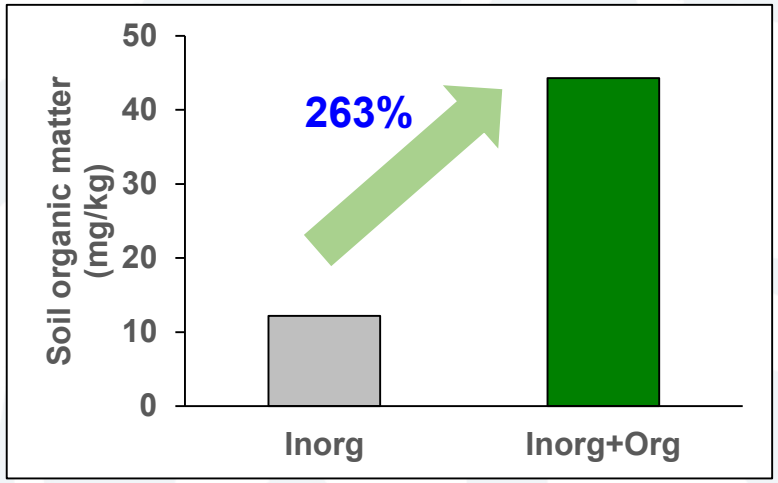
Balanced nutrition improves pomelo yield and quality

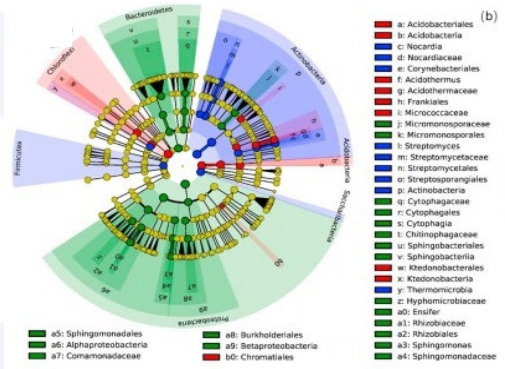




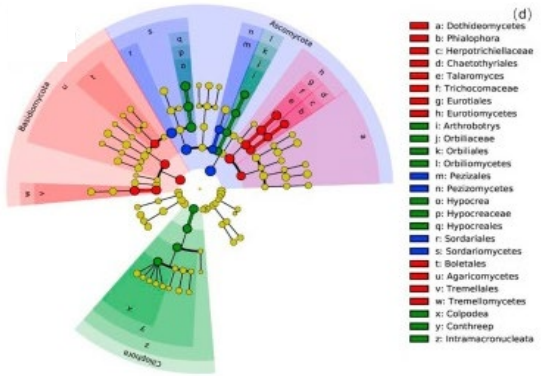


Combination of organic and chemical fertilizers promotes soil and crop health

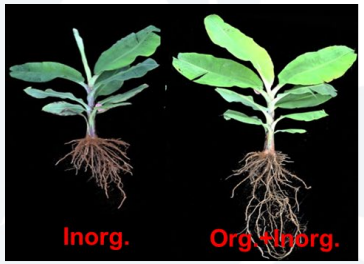




Bacteria



Fungi



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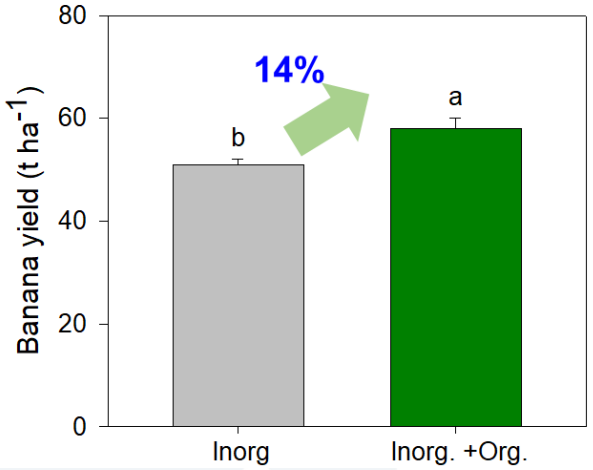

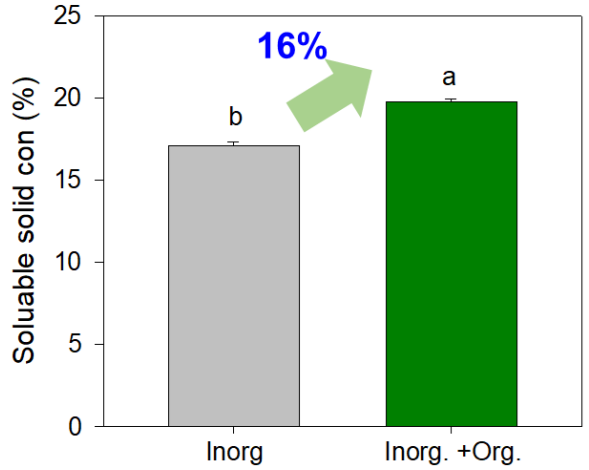

- **Organic and inorganic fertilizers improve soil organic matter and change microbial community composition and structure**
- **Promote banana health, yield and quality**

Zhang et al. 2019

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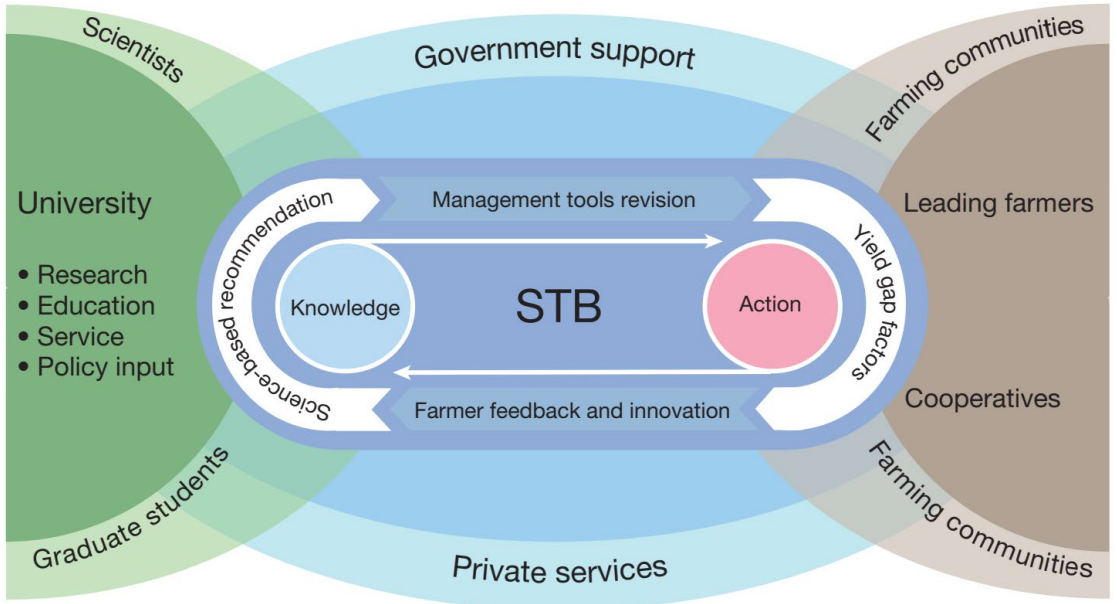
Establishing village-based Science and Technology Backyards (STBs)



Living in the villages
Working with farmers in zero-distance, zero-time lag, zero-charge and zero-personnel selection

LETTER
doi:10.1038/nature19368

Closing yield gaps in China by empowering smallholder farmers

Weifeng Zhang[1]*, Guoxin Cao[1]*, Xiaolin Li[1], Hongyan Zhang[1], Chong Wang[1], Quanqing Liu[2], Xinping Chen[1], Zhenling Cui[1], Jianbo Shen[1], Rongfeng Jiang[1], Guohua Mi[1], Yuxin Miao[1], Fusuo Zhang[1] & Zhengxia Dou[3]

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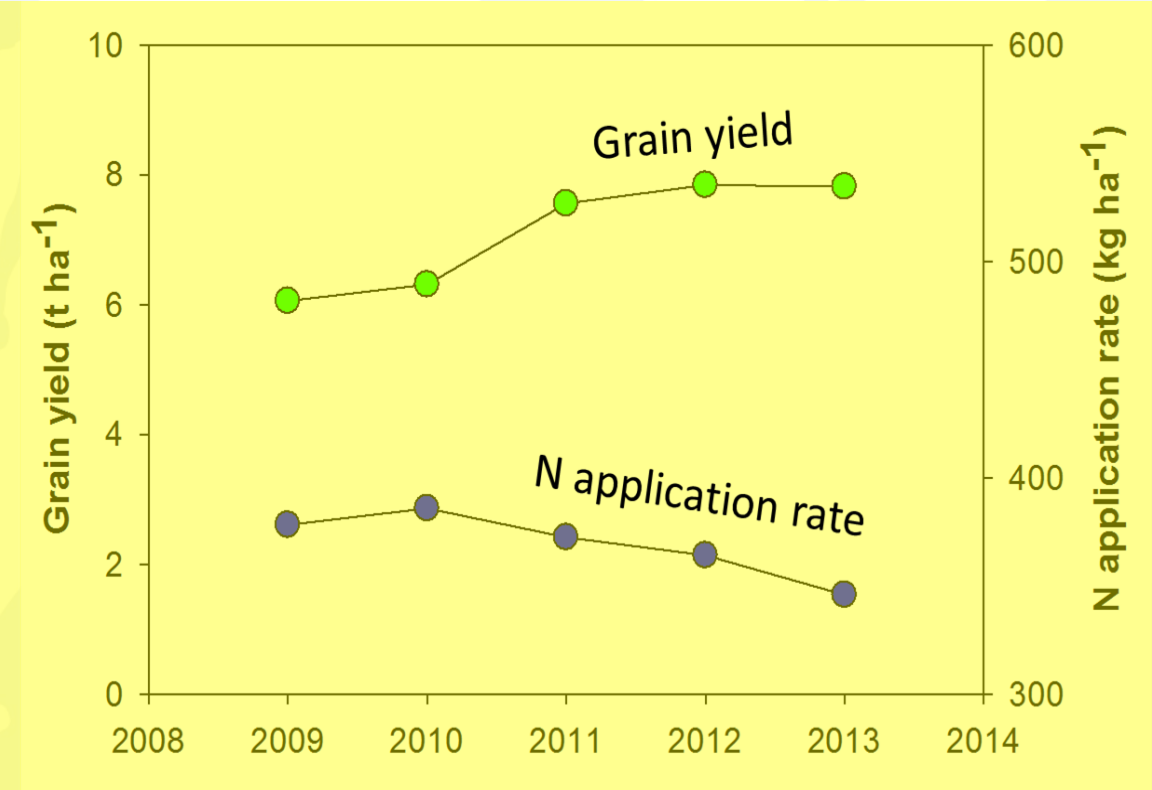
Grain yield and NUE improvements in the entire county



Smallholder farmers contribute to sustainable high productivity

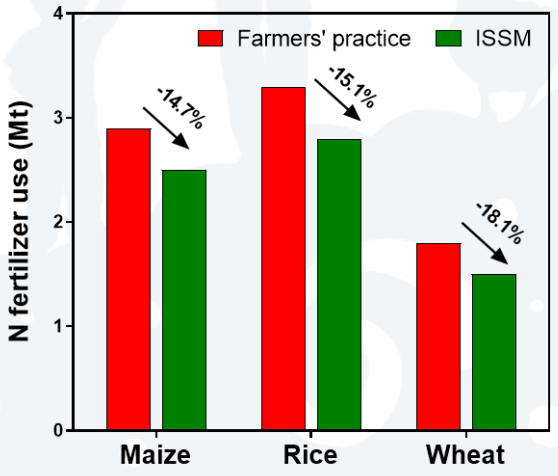
LETTER

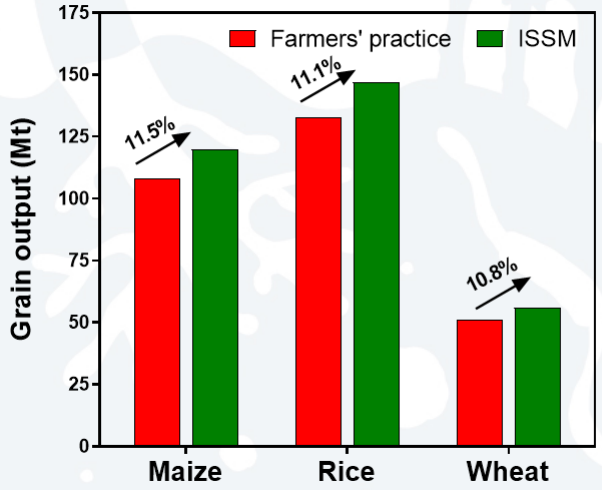
doi:10.1038/nature25785

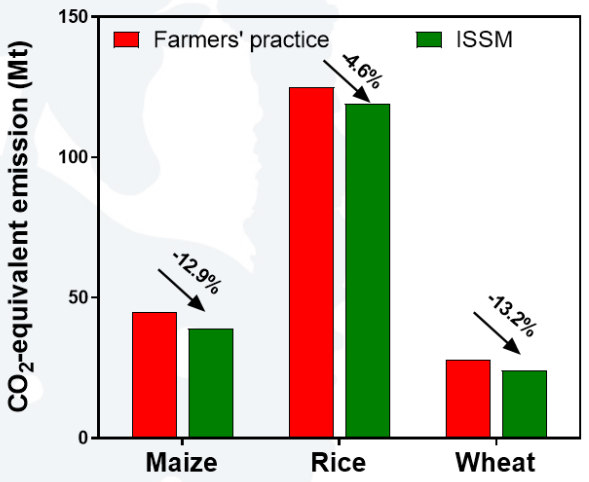
Pursuing sustainable productivity with millions of smallholder farmers

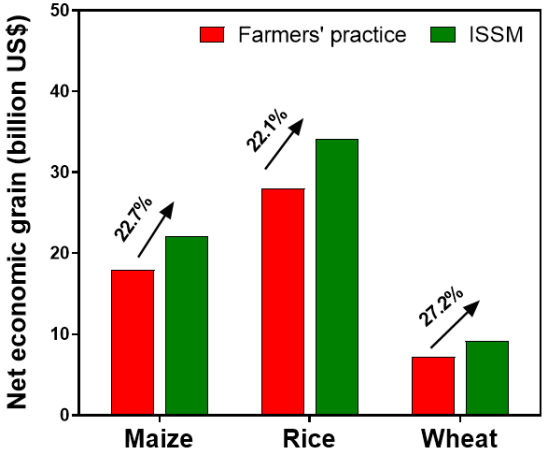
Zhenling Cui[1], Hongyan Zhang[1], Xinping Chen[1], Chaochun Zhang[1], Wenqi Ma[2], Chengdong Huang[1], Weifeng Zhang[1], Guohua Mi[1], Yuxin Miao[1], Xiaolin Li[1], Qiang Gao[3], Jianchang Yang[4], Zhaohui Wang[5], Youliang Ye[6], Shiwei Guo[7], Jianwei Lu[8], Jianliang Huang[8], Shihua Lv[9], Yixiang Sun[10], Yuanying Liu[11], Xianlong Peng[11], Jun Ren[12], Shiqing Li[13], Xiping Deng[13], Xiaojun Shi[14], Qiang Zhang[15], Zhiping Yang[15], Li Tang[16], Changzhou Wei[17], Liangliang Jia[18], Jiwang Zhang[19], Mingrong He[19], Yanan Tong[5], Qiyuan Tang[20], Xuhua Zhong[21], Zhaohui Liu[22], Ning Cao[23], Changlin Kou[24], Hao Ying[1], Yulong Yin[1], Xiaoqiang Jiao[1], Qingsong Zhang[1], Mingsheng Fan[1], Rongfeng Jiang[1], Fusuo Zhang[1] & Zhengxia Dou[25]

In China, a total of 122 Mha of cropland is managed on 200 million farms. The individual field is only 0.1~ 0.3 ha on average.









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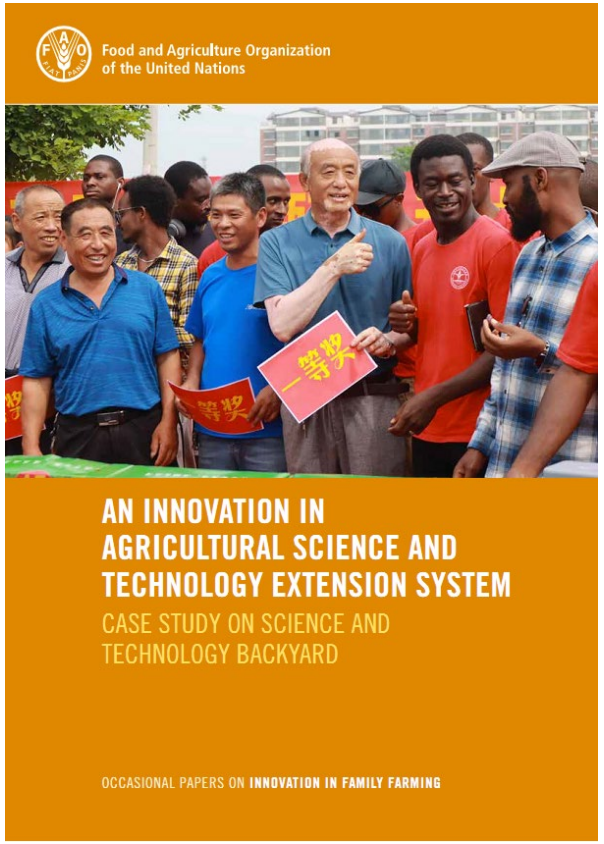
The STB model contributes to African young people growth

48 Africa students, 10 countries

Sino-Africa STB students in Quzhou



A new model for empowering smallholders in the rural area

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As an essential drive in agricultural and social development, fertilizers cross-talk with many Sustainable Development Goals (SDGs) via plant and human, soil, and environmental boundaries


Thank you !
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