Innovations to enhance agroecosystem resilience and adaptation to climate change in drylands of China

Institute of Environment and Sustainable Development in Agriculture
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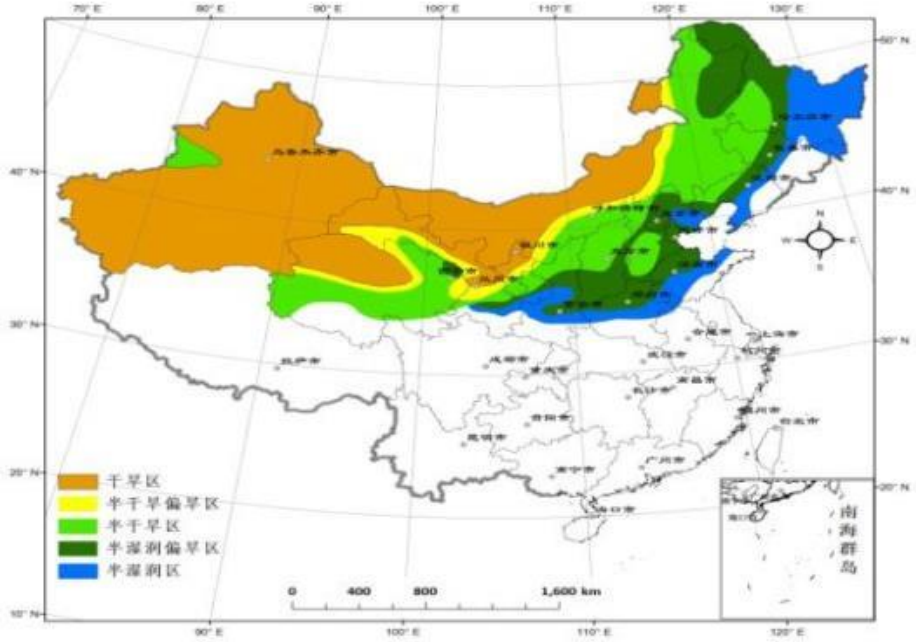
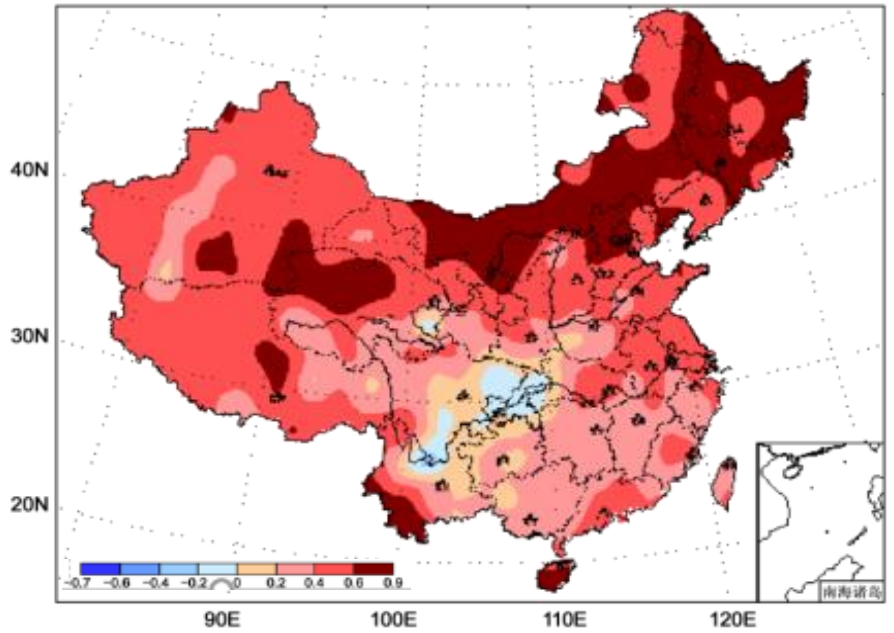
Outline

- The climate change and water crisis
- The matching of water resources, agrotechnologies and crops
- The innovation R&D, extension and adoption

The importance of enhancing resilience and adaptation of agriculture to climate change in the drylands of North China



The dryland area in North China



Mean annual temperature changes (1951-2001)

Cultivated land area	**51%**
Water resource	**19%**
Total grain yield	**59%**
Dryland grain yield	**30%**
Vulnerable ecological area	**70%**

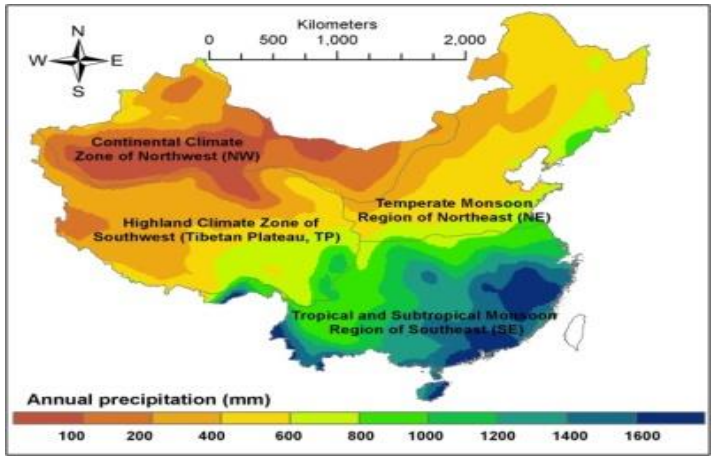
Annual air temperature ↑ **~1.1℃**

Warming rate ~ **0.22℃/10a**

(China Climate Change Info-Net)

Matching the precipitation with innovative technologies and crop patterns

Precipitation



- The increased frequency of severe drought in northern regions of China
- Precipitation meeting crops' need decreased 5%

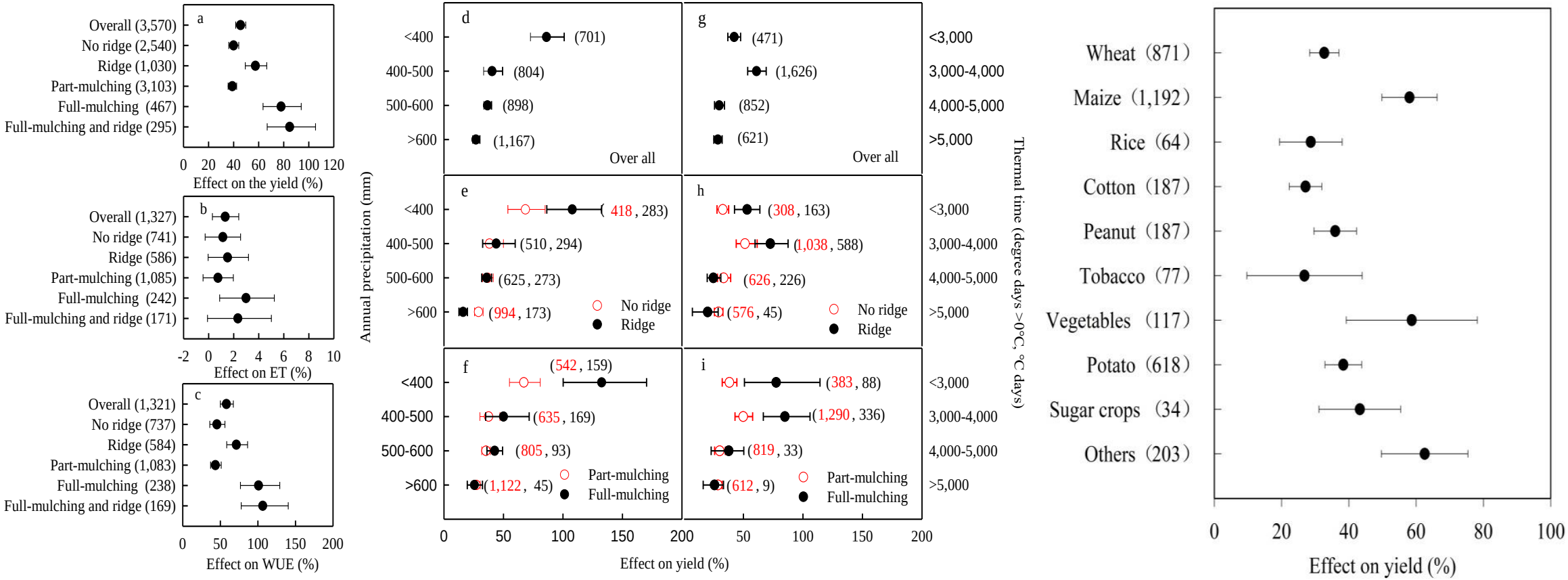
Agrotechnologies

- Residue incorporation
- Plastic mulching
- Cropping systems
- Tillage
- Fertilization
- Irrigation techniques

Crop species

- Maize
- Wheat
- Potato
- Soybean
- Cotton
- Others

Plastic mulching increases crop yield and water use efficiency (WUE)



Plastic mulching effect on yield and WUE for different crop species of China

Mulching area for crops **13%**

Crop yield ↑ **45.5%**

WUE ↑ **58.0%**

(Sun et al., 2020)

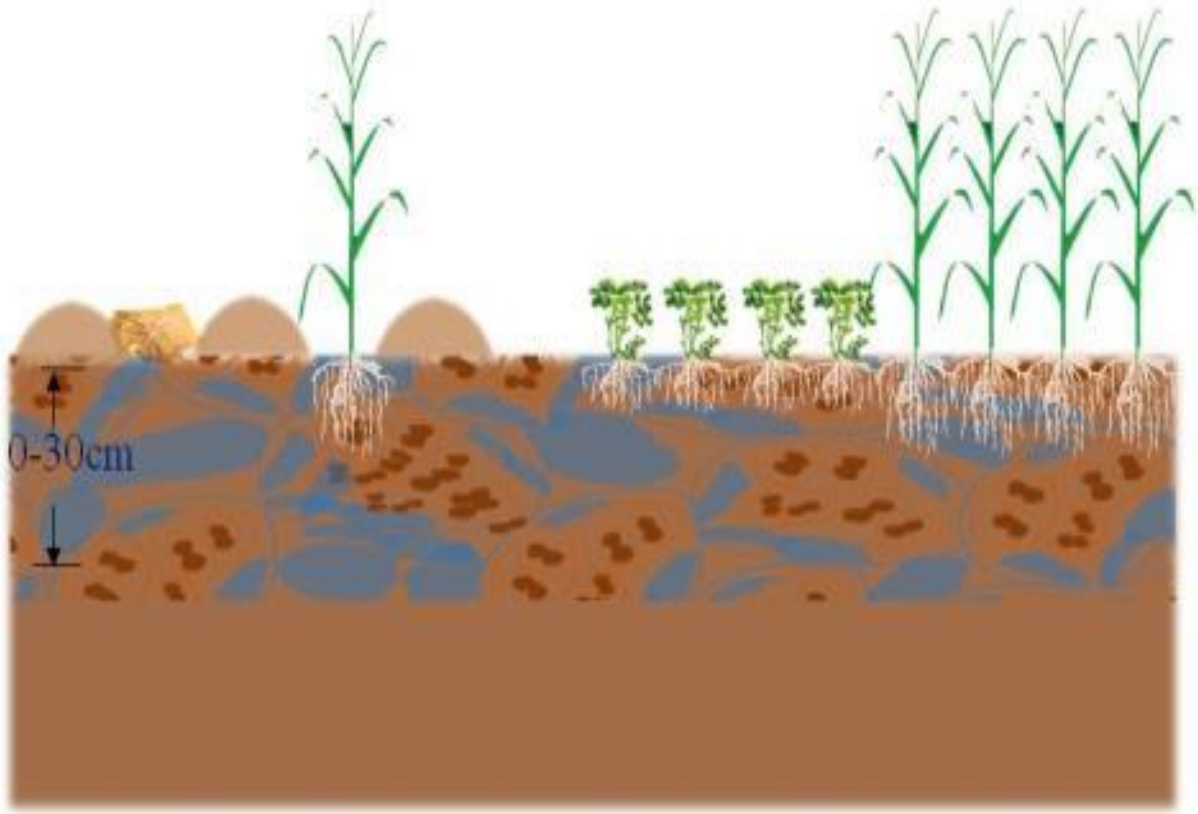
Innovation R&D—Soil-Crop canopy system approaches

Canopy manipulation

- Intercropping
- Rotation
- Planting density

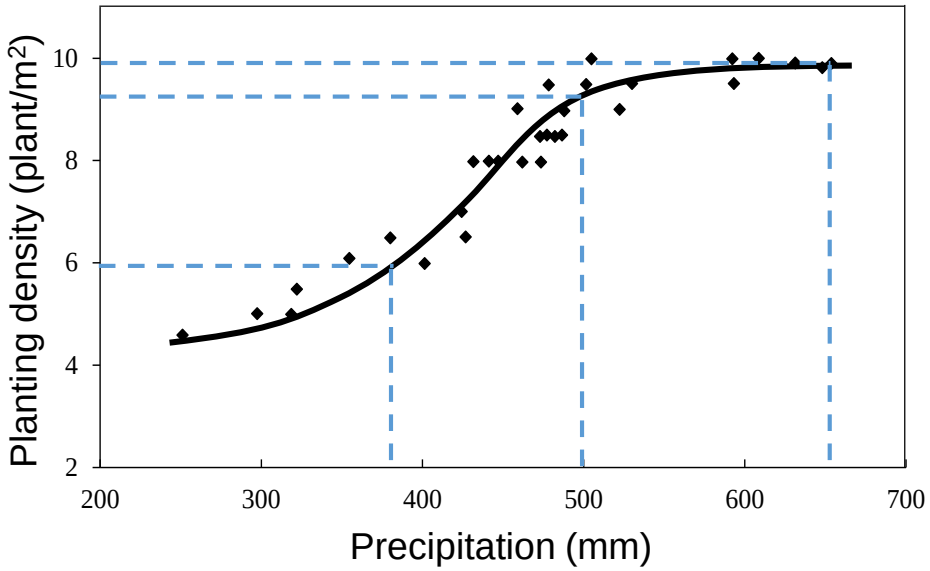
Soil management

- Plastic/organic mulching
- Organic input
- Deep/reduced tillage
- Green manure



Canopy manipulation

- Planting density

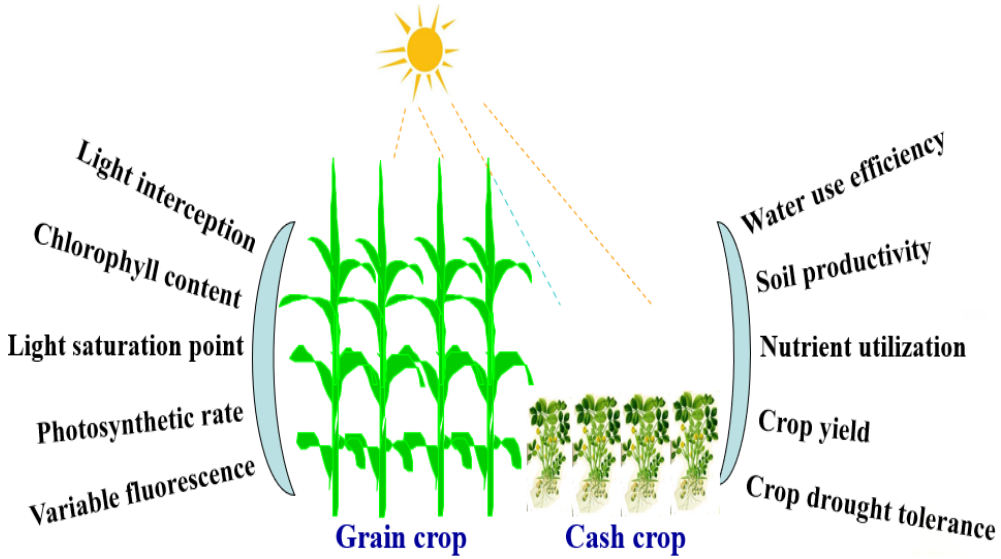


Crop transpiration ↑ **300-550 mm**

Crop yield ↑ **12.0%-20.6%**

WUE ↑ **12.7%-17.4%**

- Intercropping



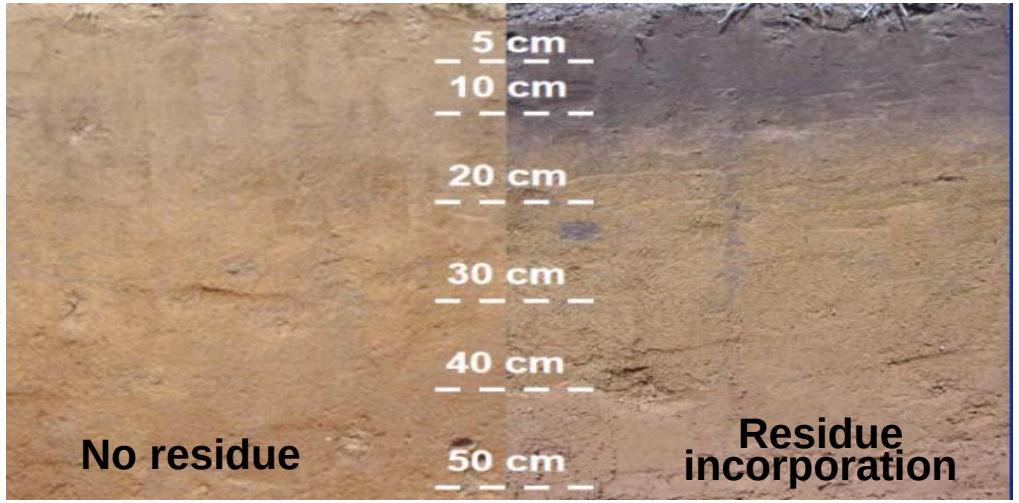
Millet-peanut intercropping,
Precipitation interception infiltration ↑ **45%-69%**

Maize-soybean intercropping,
Radiation interception ↑ **13%-19%**

WUE by intercropping ↑ **21%**

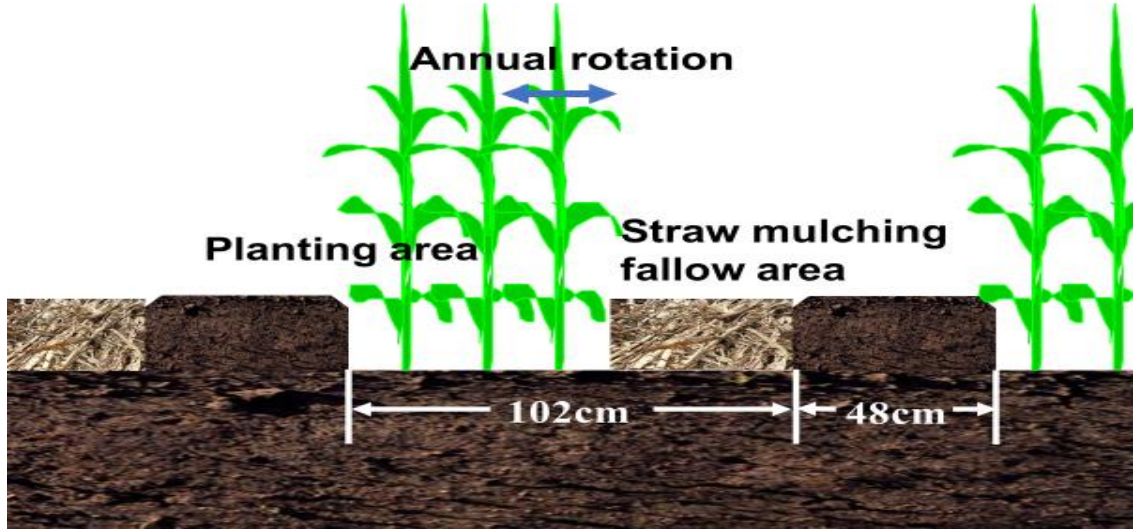
Soil management

- Organic input
- Deep tillage



Water holding capacity	↑ **12%-23%**
Carbon footprint	↓ **15%-29%**
Crop yield	↑ **>10%**
Yield fluctuation	↓ **15%-27%**

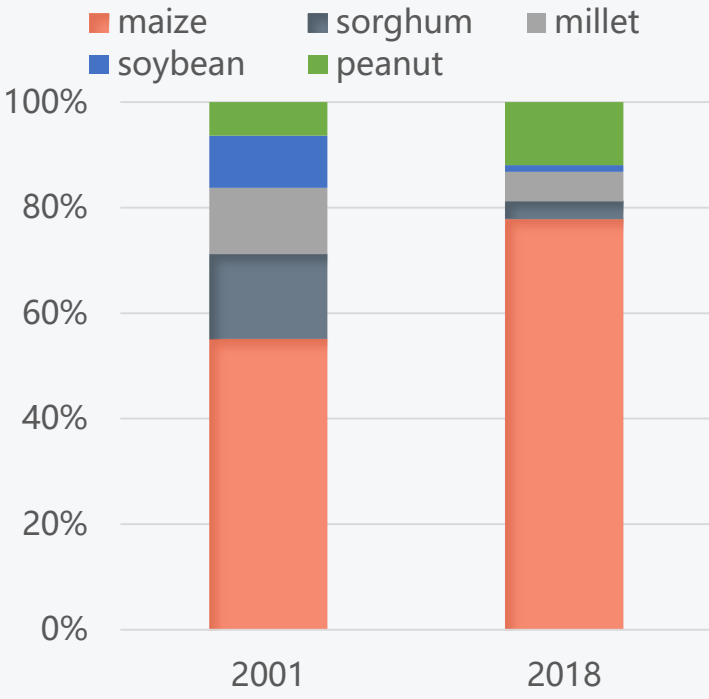
- Organic mulching
- Plastic mulching



Soil water storage	↑ **25.4 mm**
Soil evaporation	↓ **8.9 mm**
Soil wind erosion	↓ **0.45 t/ha**

Innovation extension and adoption—Northeast China

Crop species



Precipitation WUE ↑ **14%-19%**

Soil erosion ↓ **36%-43%**

WUE by maize and peanut intercropping ↑ **19%**

Agrotechnologies

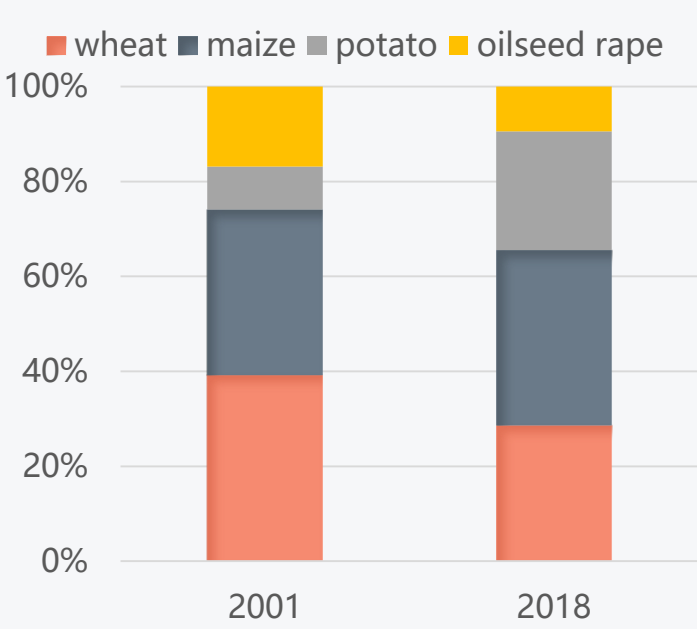
Intercropping improving resource efficiency

Straw mulching preventing soil erosion

Deep tillage increasing soil water storage

Innovation extension and adoption—Northwest China

Crop species



Precipitation WUE **73.2%**

Soil water storage ↑ **20-30 mm**
(before seeding)

Spring maize WUE **~40.35 kg/mm·ha**

With a maximum of **54.6 kg/mm·ha**

Agrotechnologies

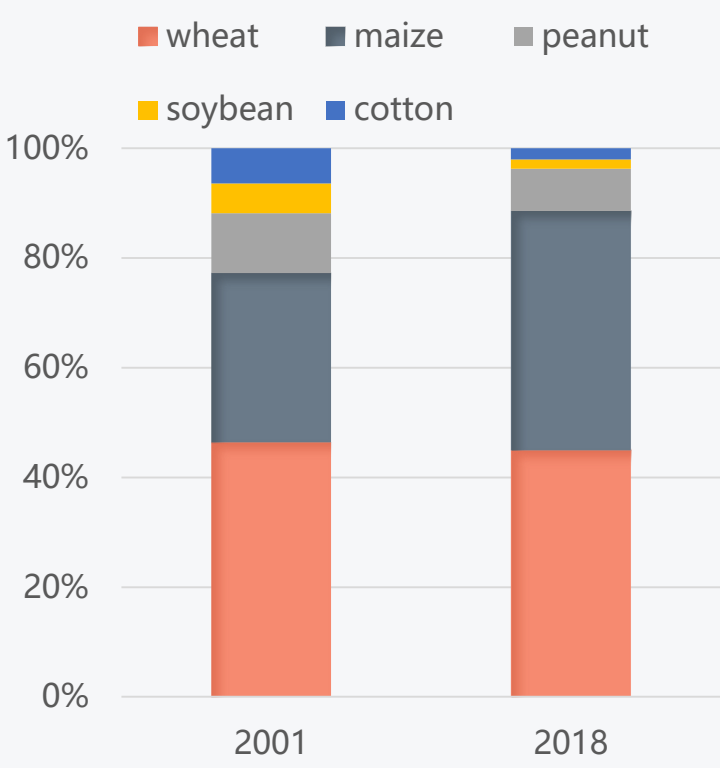
Optimized planting density utilizing resources more efficiently

Furrows and ridges plastic mulching collection more rainfall

Green manure during fallow periods increasing soil health

Innovation extension and adoption—North China Plain

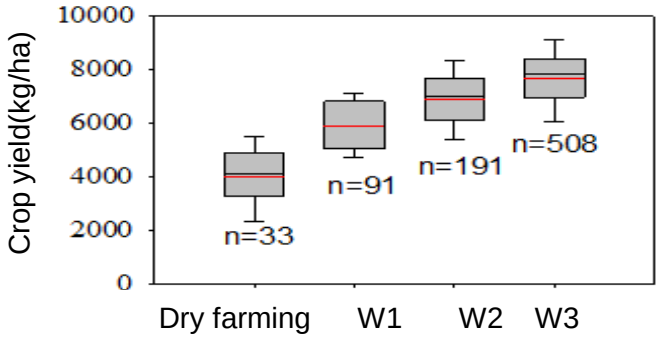
Crop species



Irrigation water ↓ **750 m³/ha**

Winter wheat WUE ↑ **~10%**

Agrotechnologies



Deficit irrigation and reduced water input

Drip irrigation with fertilizers increasing resource use efficiency

Deep tillage improving soil physiochemical properties

THANK YOU

Your valuable comments and suggestions are highly appreciated.