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# Harmonising ecosystem services in dryland by multifunctional land use

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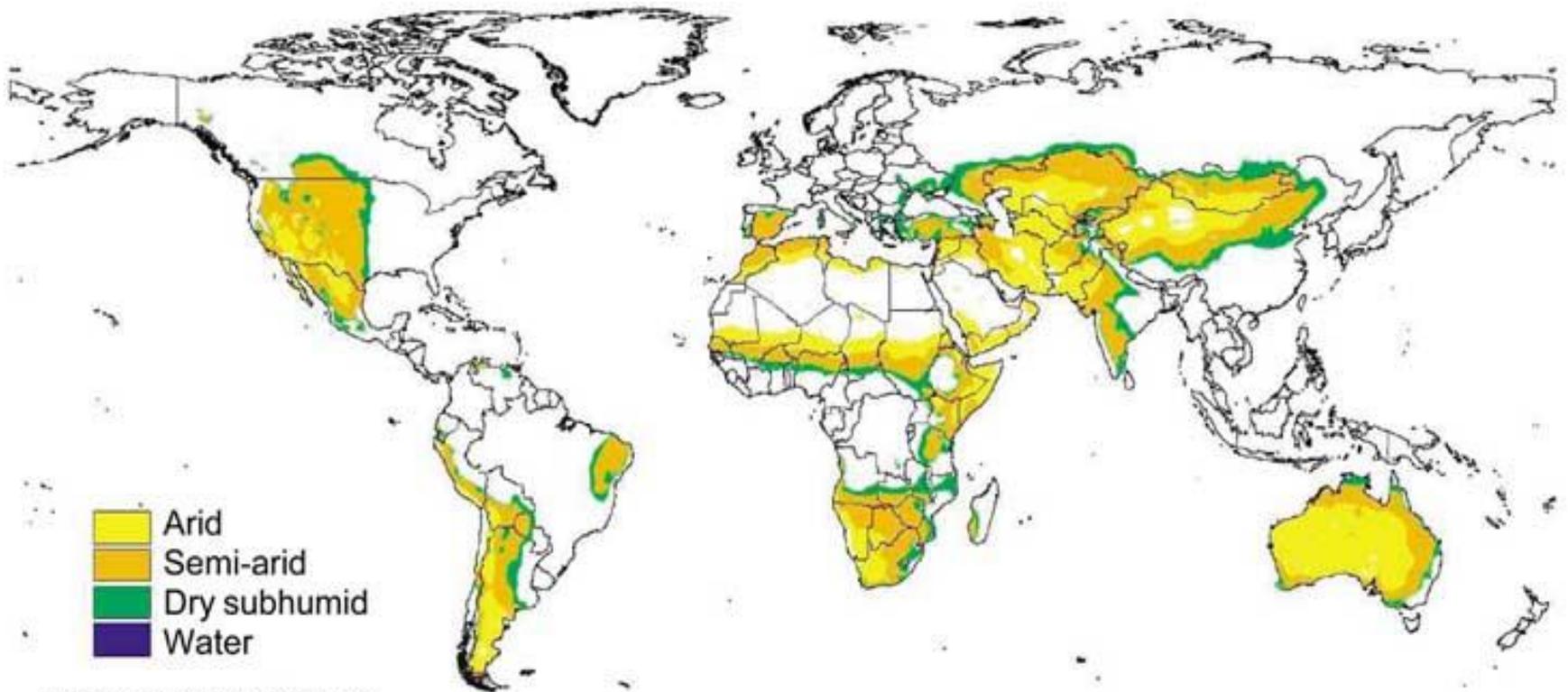
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# Global Development Problems

## Dryland

41% of global land surface and supports 1/3 world's population



Grid Resolution 5 x 5 minutes  
Geographic Projection (lat/long)

[Source: FAO]



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# Restoring China's Environment

## Land Policies after Opening Up (1978)

1978

- North Shelterbelt program

1986

- Rural household responsibility

1994

- Protection of basic farmland

2000

- Grain for Green

- ✓ minimize soil erosion and degradation
- ✓ protect farmland
- ✓ promote the use of farmland for agriculture



# Land terracing & revegetation in the Loess Plateau Region



## The Loess Plateau, NW China

- Low vegetation cover
- Water scarcity, drought
- Severe soil erosion
- Land degradation



- A long-term strategy to increase forest to remediate soil erosion
- Build of terrace and check-dam farmland for agriculture



Are they adequate measures?

- To ensure both soil & water-related ecosystem services
- Adaptations to climate change

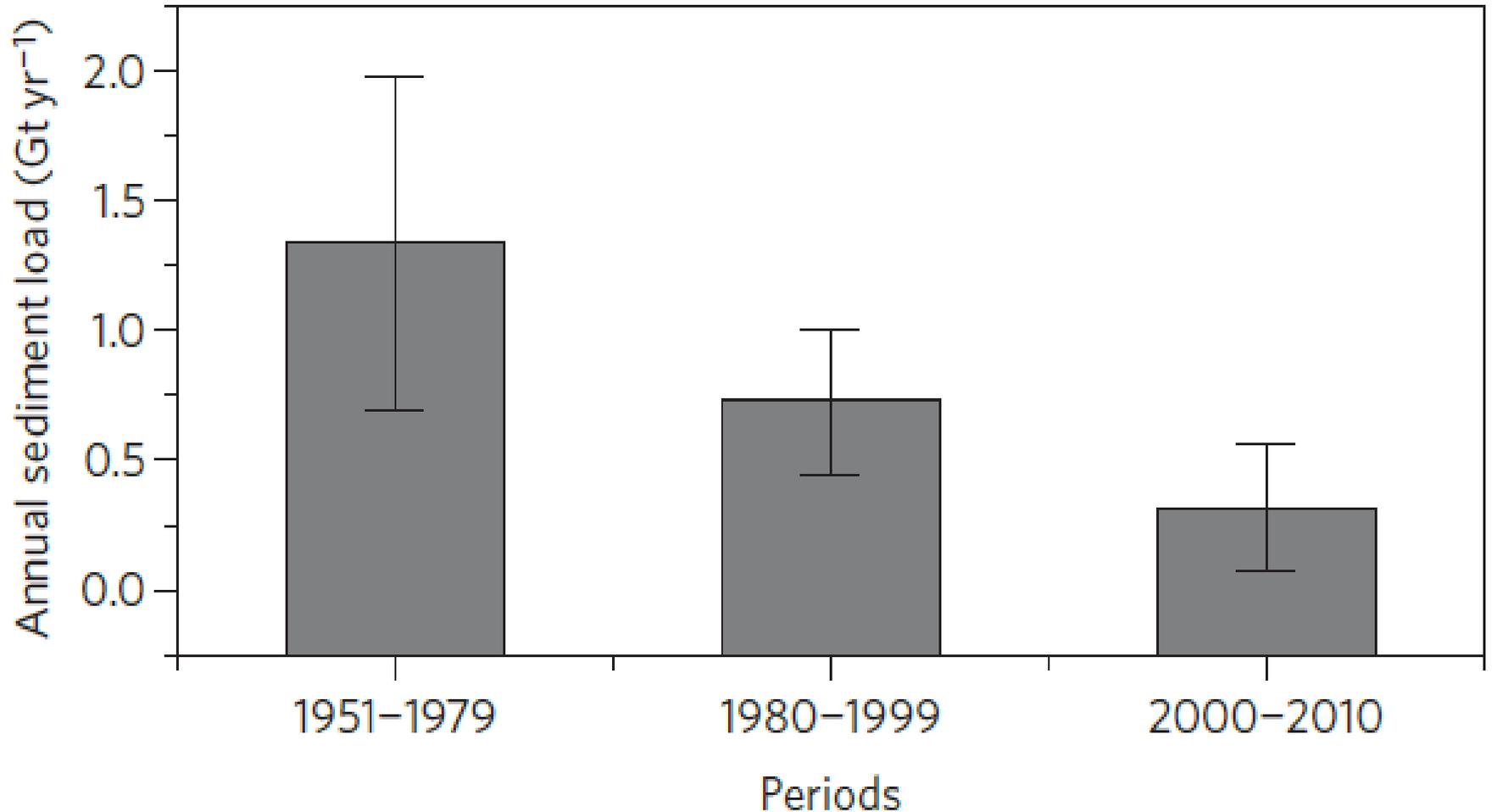




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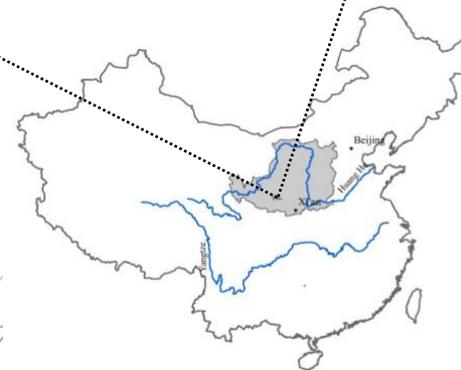
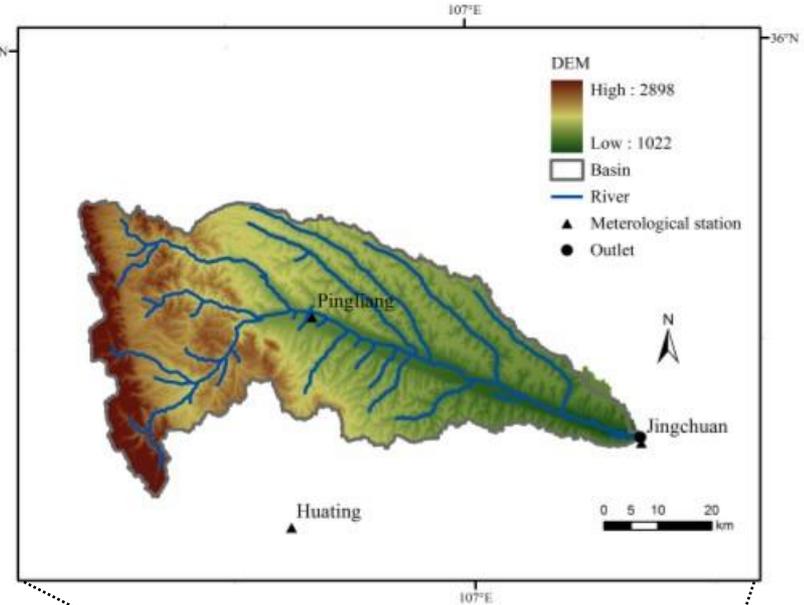
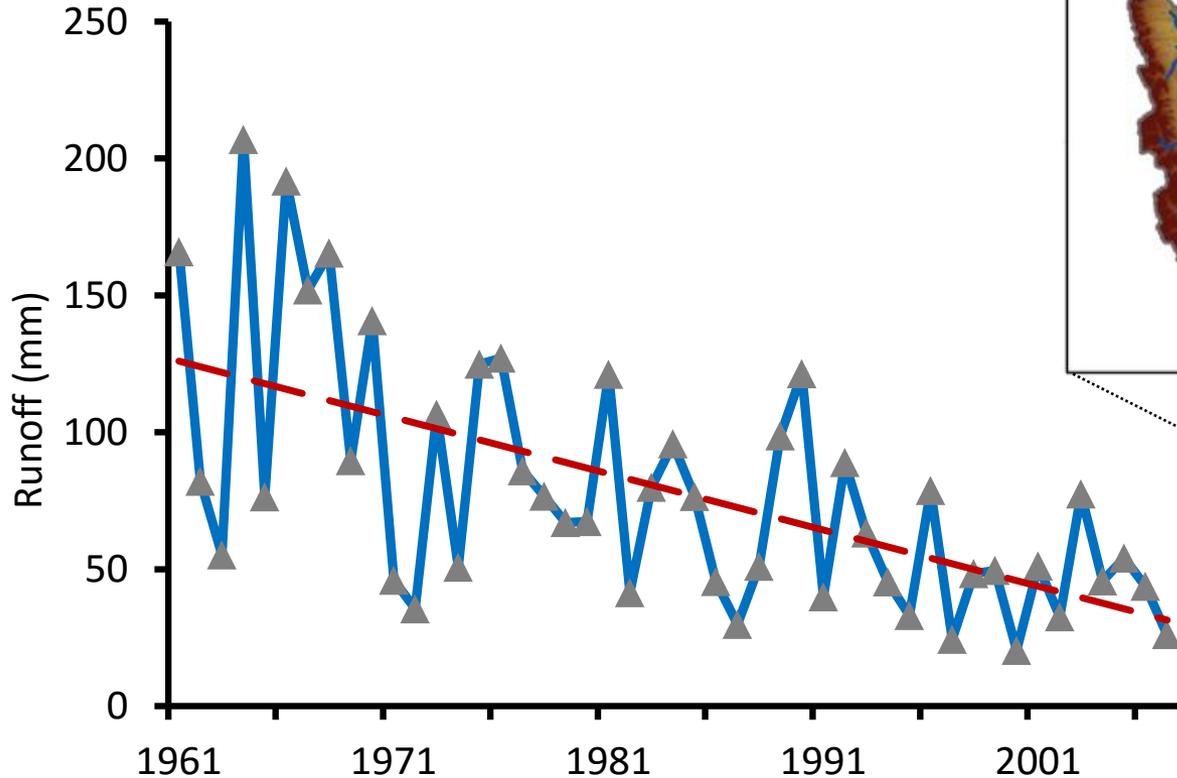
# Soil Sediment Load in Yellow River from the Loess Plateau Region



[Wang et al, 2016, Nature Geoscience]

# Decline in runoff in catchments of the middle reaches of the Yellow river

Upper Jinghe watershed 3080 km<sup>2</sup>





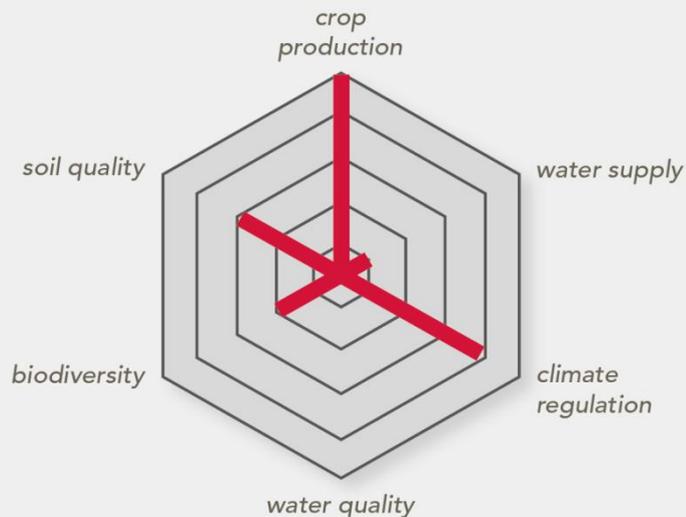
# Impact of soil conservation measures on discharge based on a modified “Budyko”

Land use / land form	Early 1970s	2013
farmland on slopes	65%	25%
forests	5%	25%
grassland	17%	20%
terraces	13%	30%

# Conclusion: Move from Sector to Cross-sector

- Silo and single-function focused land policy (e.g., afforestation for soil erosion control) creates imbalanced soil and water related ecosystem services in land use system (e.g., forest) of dryland China
- Change of management mindset to integrate measures for balancing different services demand is necessary

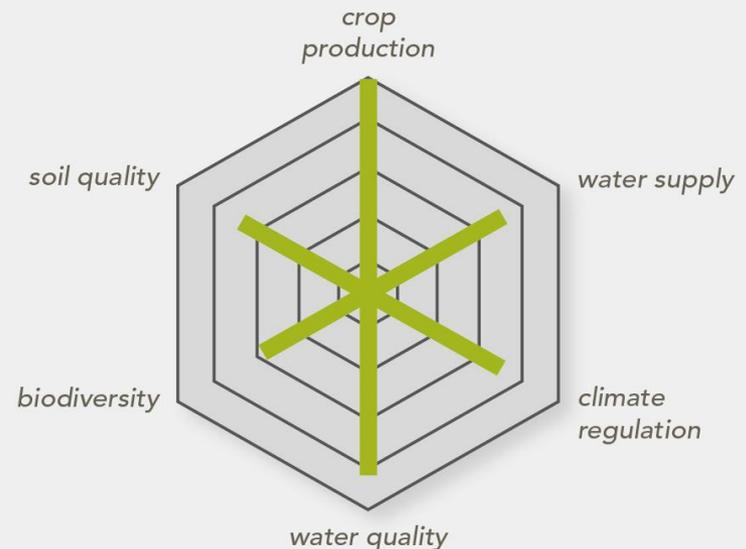
## Current Situation



Sector-oriented

Cross-sector

## Future Vision

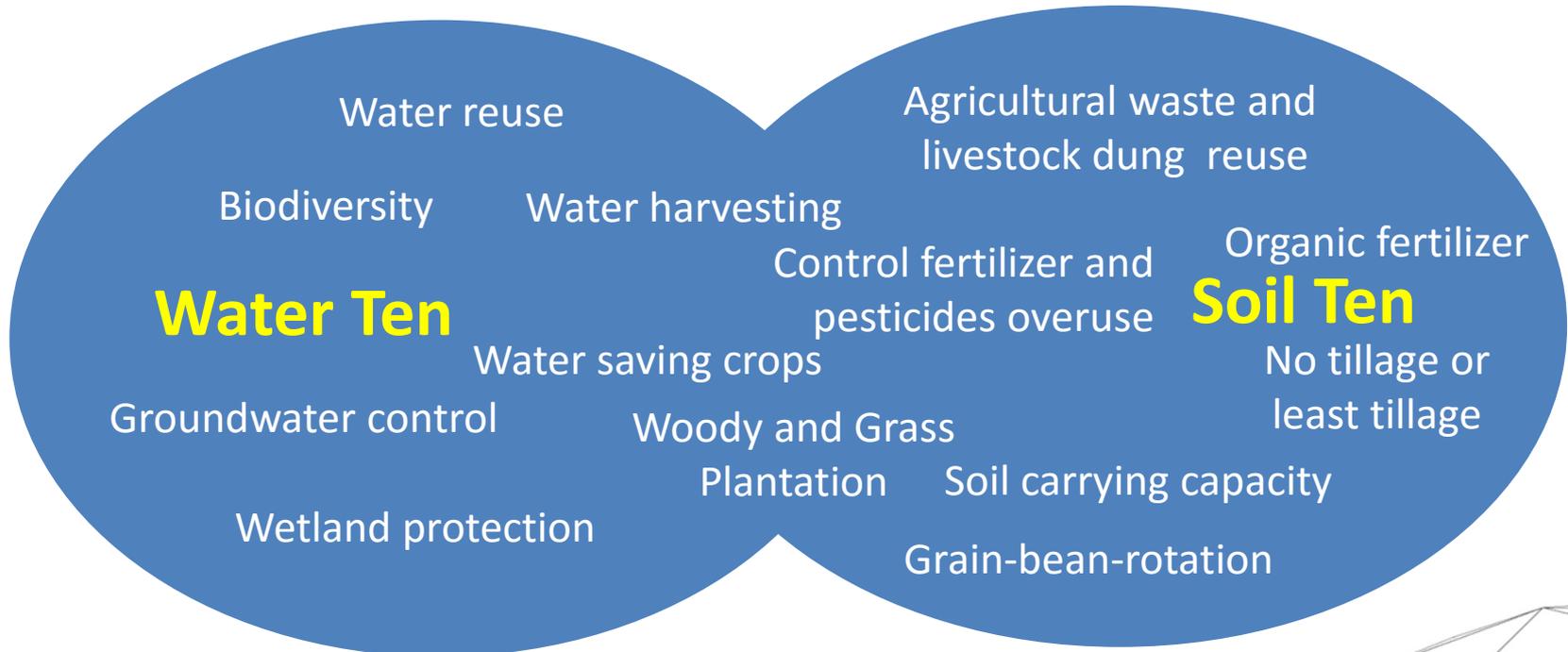




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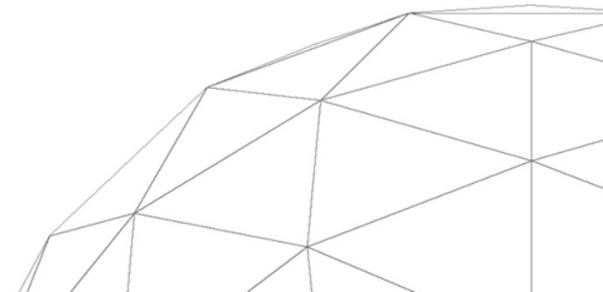
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# New action in China: Water Ten & Soil Ten



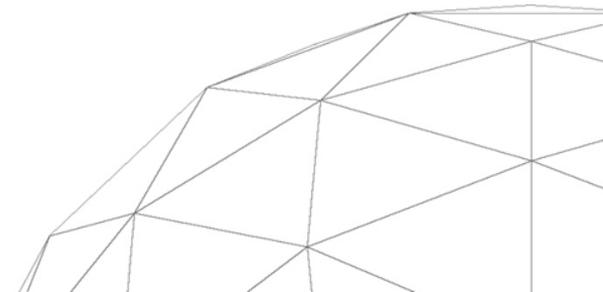
# Recognising problems is only halfway to problem-solving

- New policies provide *neither* guidelines *nor* operational concepts on how to implement measures at site, watershed and landscape scales
- The plans remain non-operational for landholders and practitioners and increase risk of failure
- **Multifunctional land use** might be the way to implement China's new policies



Soil, water, and economic benefits of forest ecosystem services have to be balanced by establishing measures that are able to

- **Maintain & improve** water quantity and quality
- **Maintain & improve** soil quality and fertility
- **Create** social resilience to changes and economic benefits (e.g., income sources from agroforestry & bioenergy)

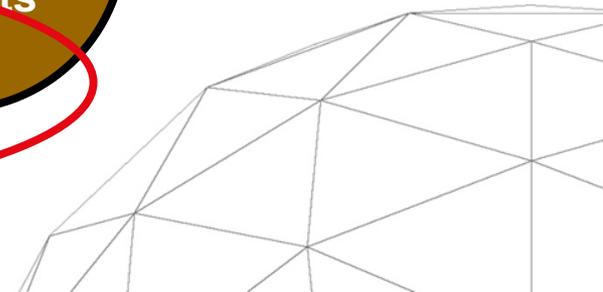
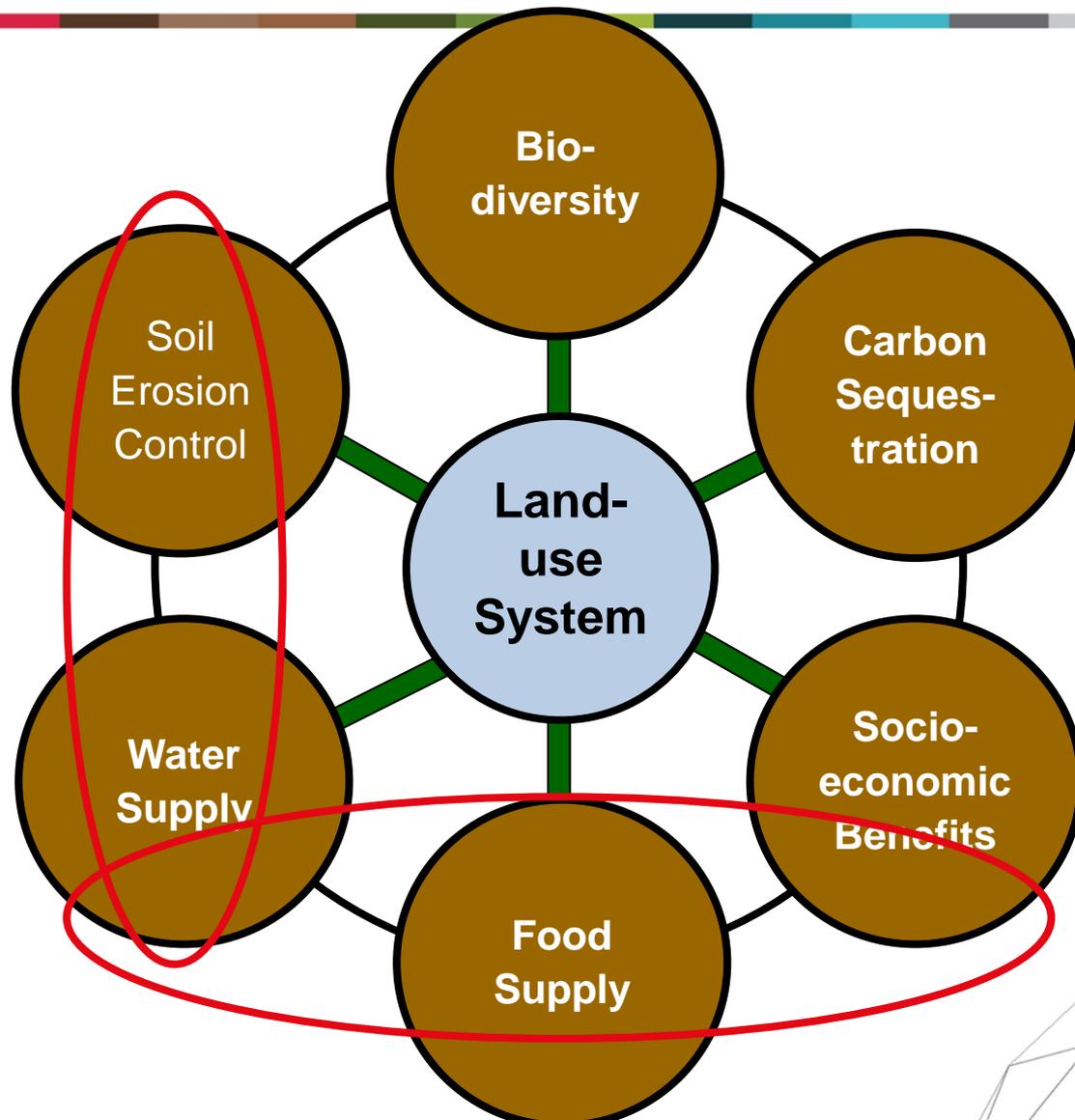




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# Trade-offs of ecosystem services





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# Research needs

1. Holistic understanding of spatiotemporal dynamic interlinkages between land-use, soil and water ecosystem services, as well as their interactions with other ecosystems
2. Knowledge about threshold to recover the hydrological ecosystem services
3. Develop more transdisciplinary land management policy for minimizing the trade-offs between different environmental resources and ecosystem services



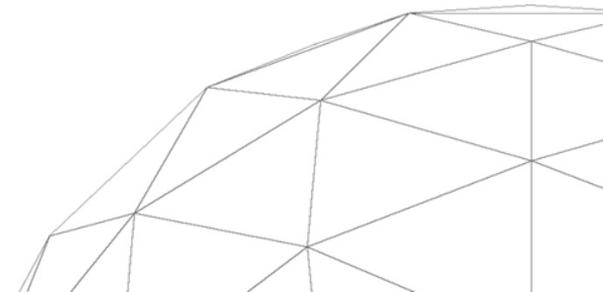


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# How to formulate right management path?

- Good science → China case in Panel Discussion
- Social acceptance and socio-economic feasibility
- Policy support
- Incentives
- Payment schemes





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**Thank you for your attention**

# Multifunctional Land-Use Systems for Managing the Nexus of Environmental Resources

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