



XVIII World Water Congress

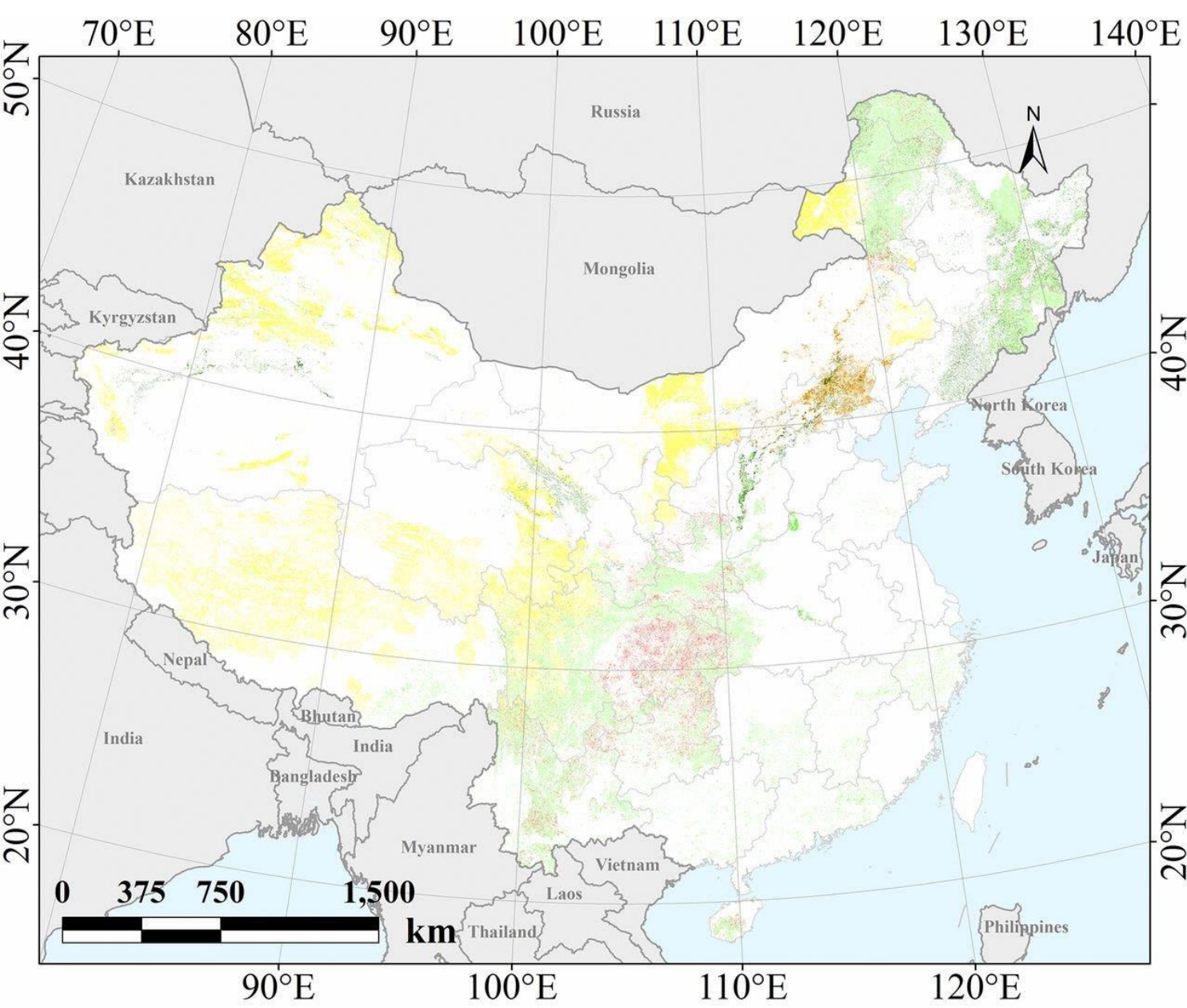
Ecological Risks Arising for the Regional Water Resources in Inner Mongolia due to a Large-scale Afforestation Project

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- GGP
- North Shelter Forest 4th Phase
- River Shelter Forest 2nd Phase
- Forest Protection
- Sand Control
- Grassland Conservation

Ecological restoration projects in China

since the late 1970s

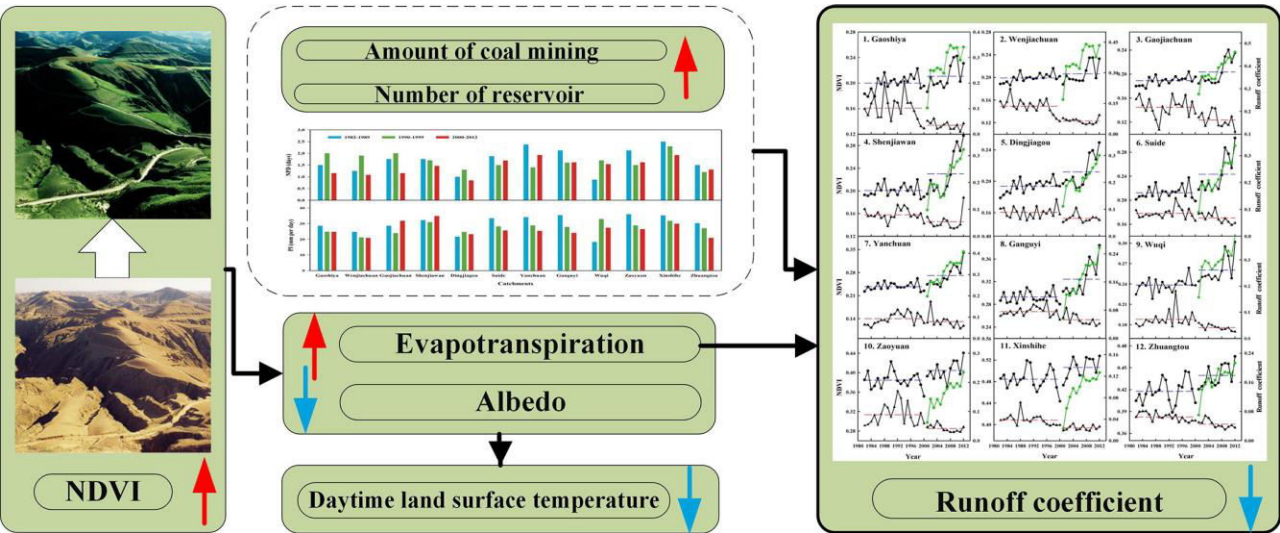
- six key national ecological restoration projects
- ~16% of the country's land area
- China contribute ~25% of the world

Greening

(Lu et al., 2018 PNAS)

(Chen et al., 2019 Nat Sustain)

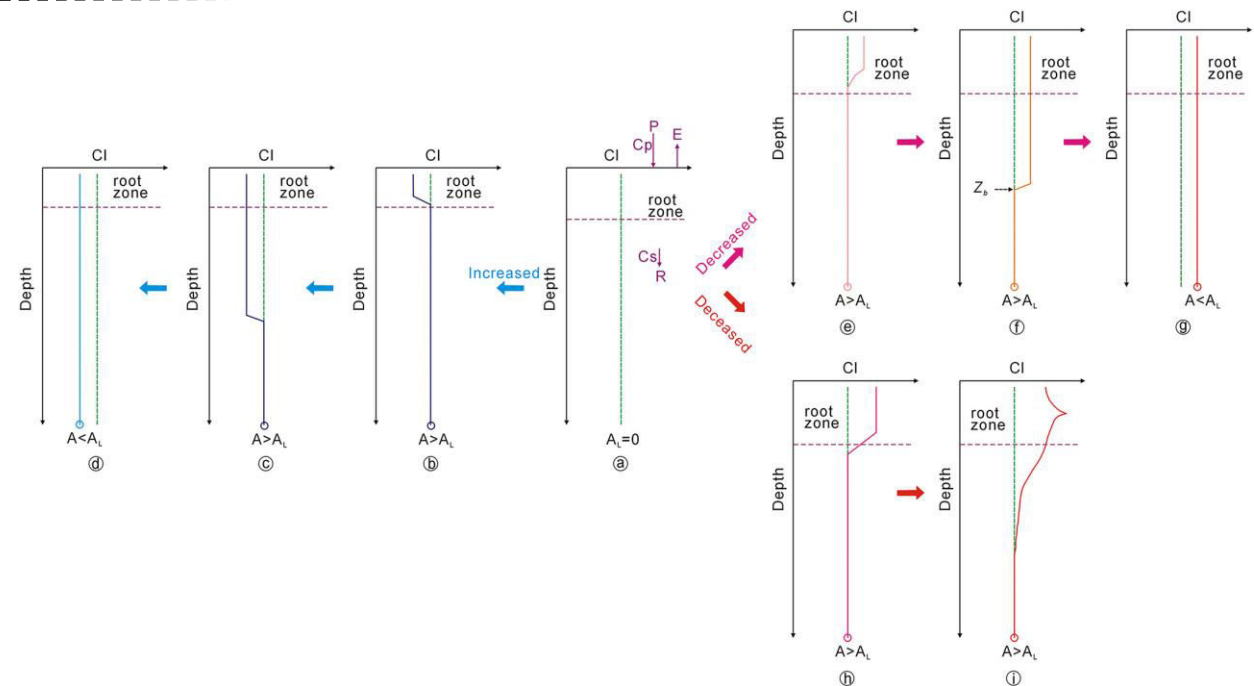
Impact of Ecological Restoration Project on Water Resources



China's Loess Plateau

More evapotranspiration from restored vegetation is the primary reason for the reduced runoff index.

(Li et al., 2016, *Sci. Total Environ*)

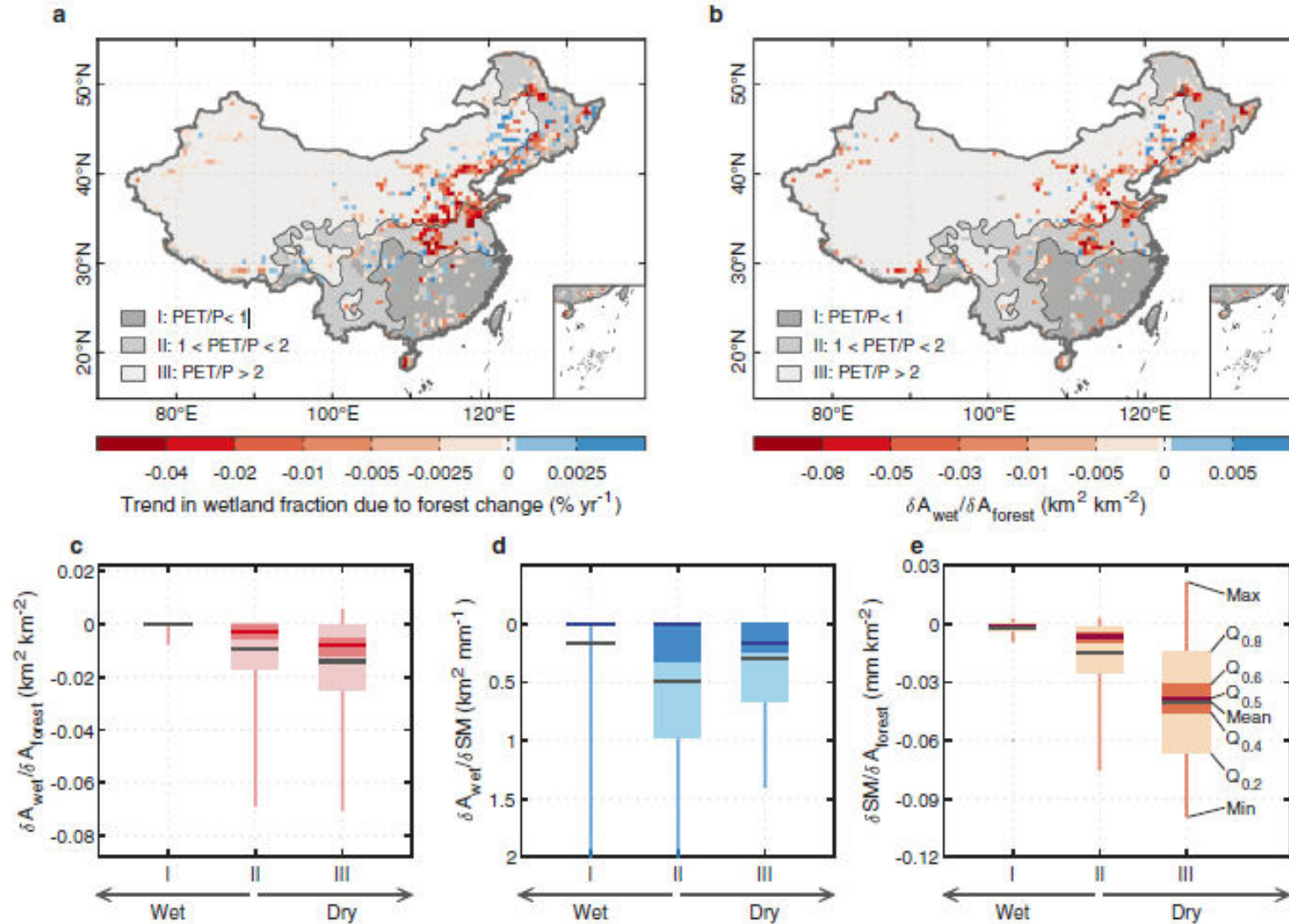


Mu Us Sandy Land

The estimated recharge rates beneath the plantations represent reductions from **33% to 90%** relative to the surrounding bare sandy land (50–54 mm/year).

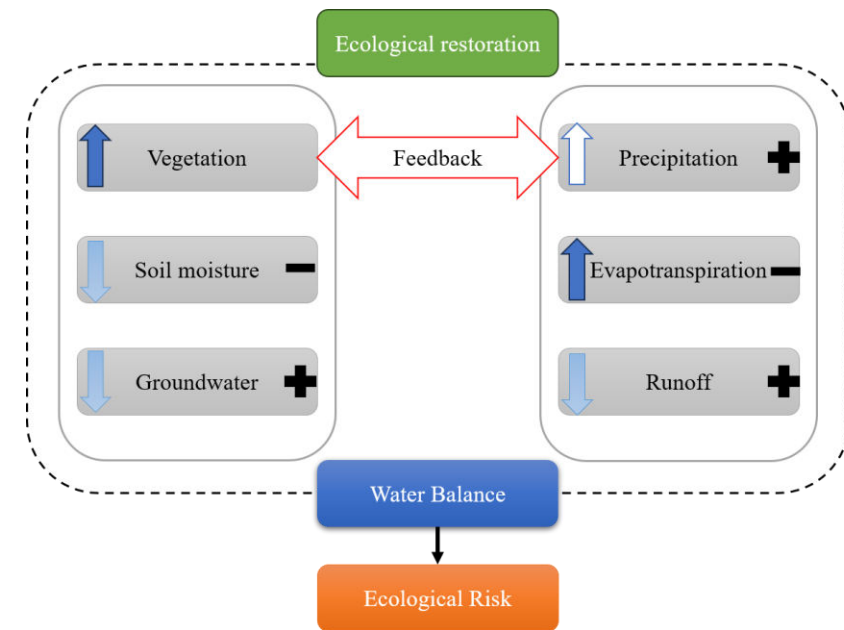
(Huang et al., 2020 *JGR Atmospheres*)

Impact of Ecological Restoration Project on Water Resources



- Afforestation affects regional ecohydrological processes
- The drier the area, the greater the loss of water resources

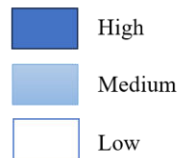
Framework



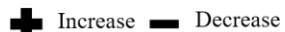
ER impact on water resource



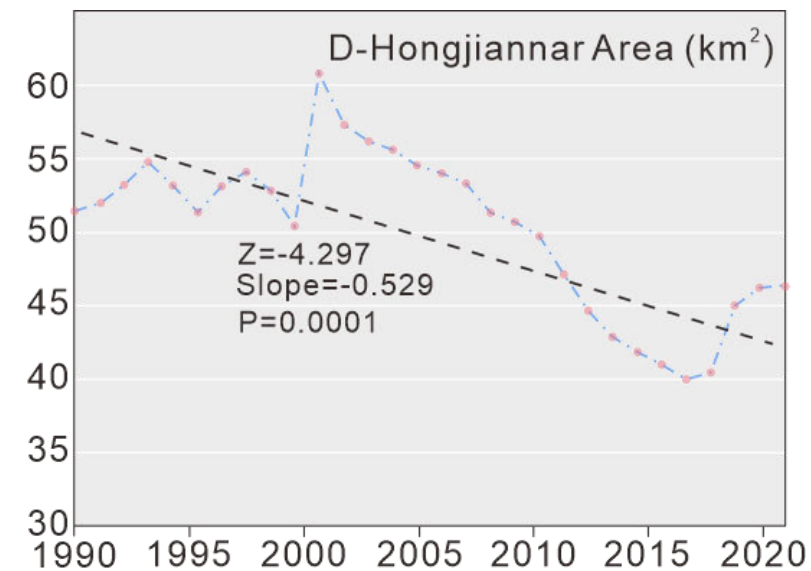
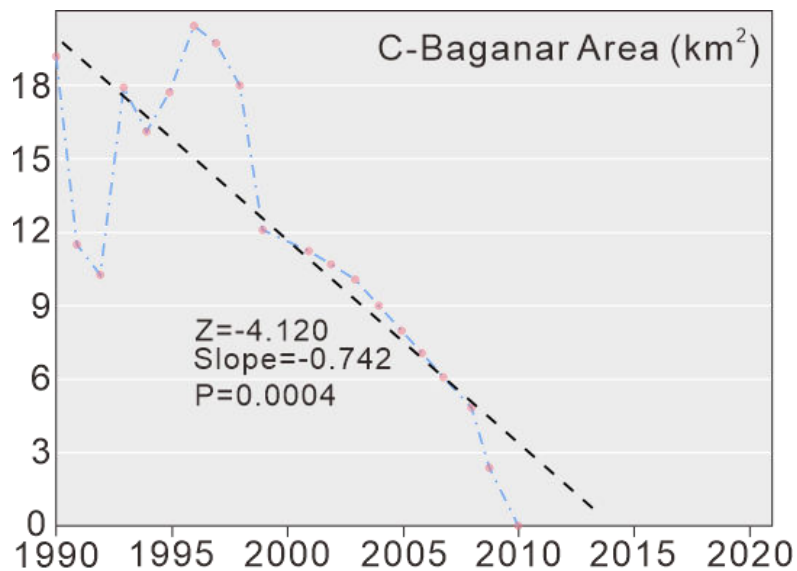
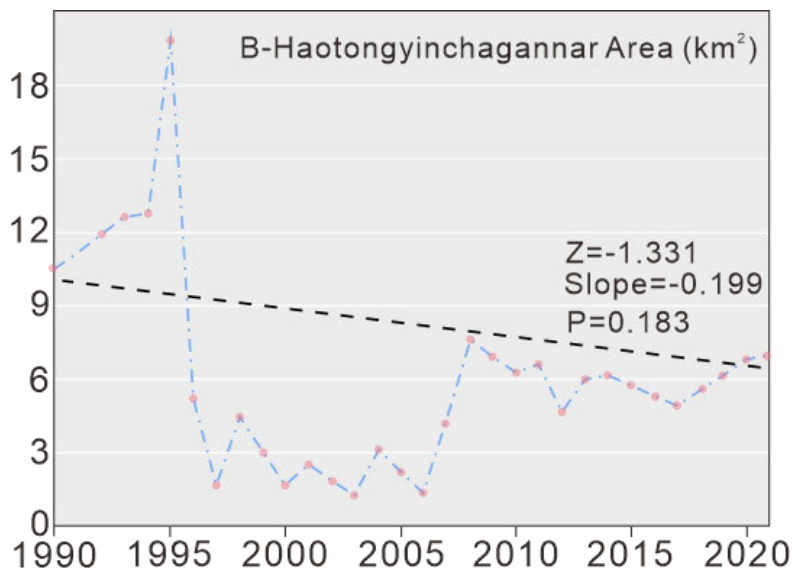
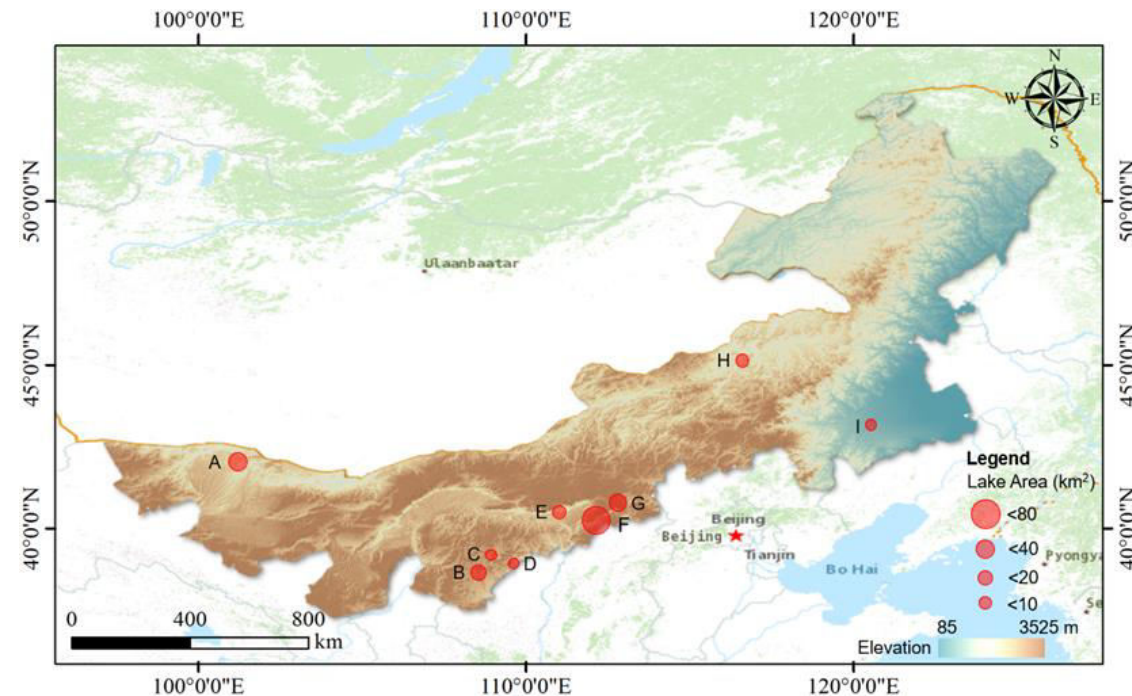
Agreement in the literature



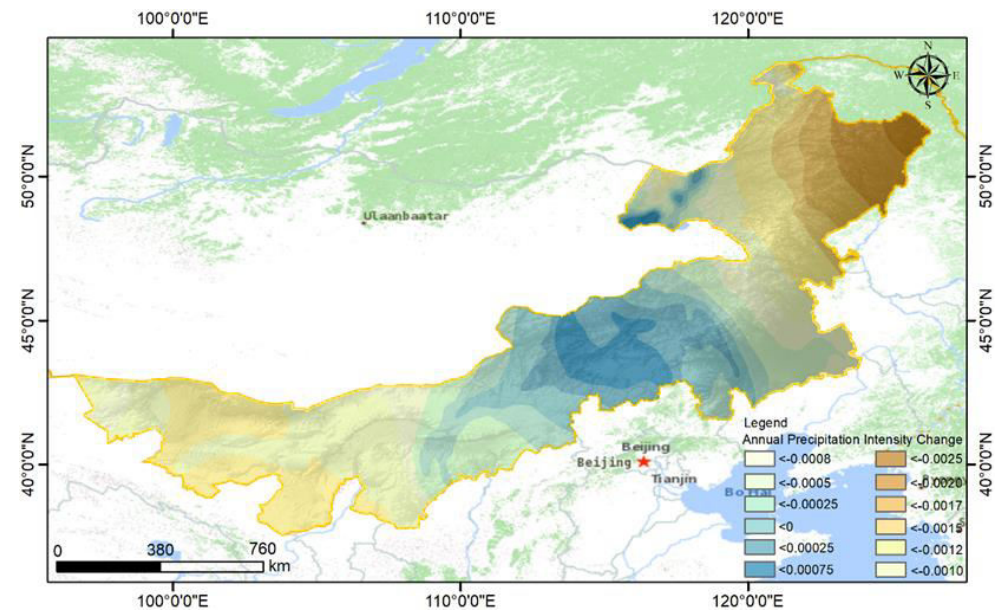
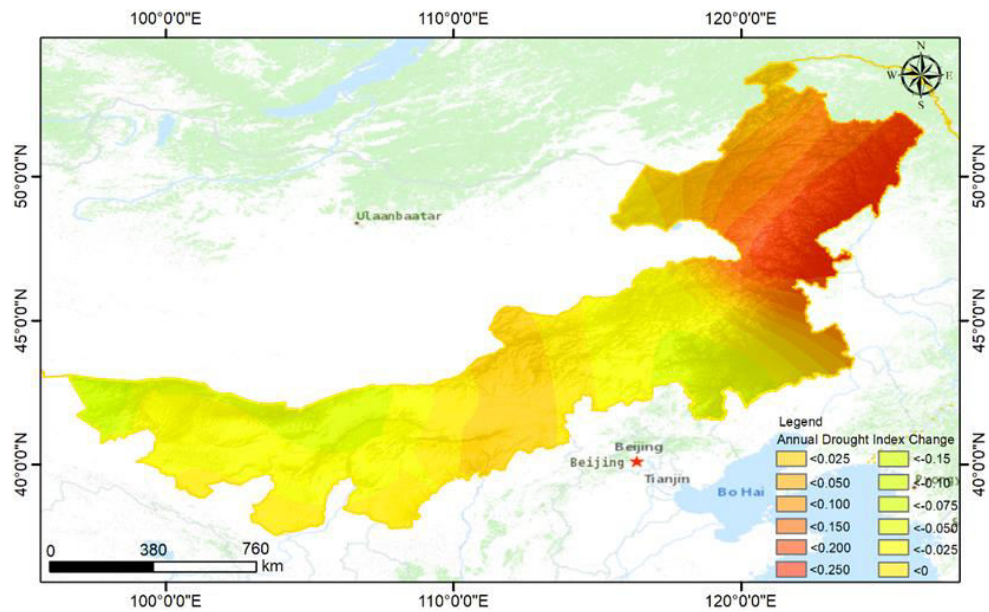
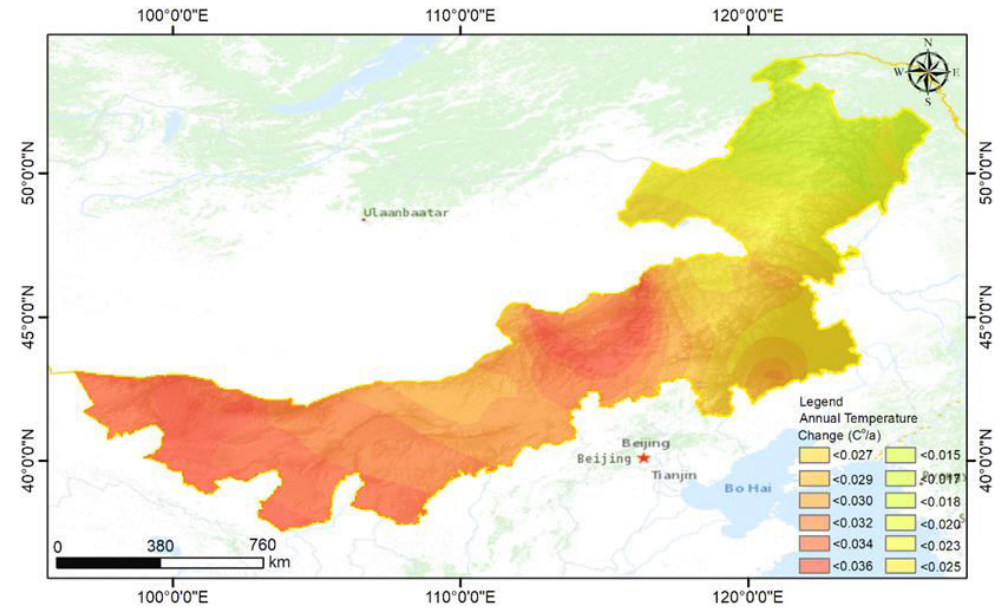
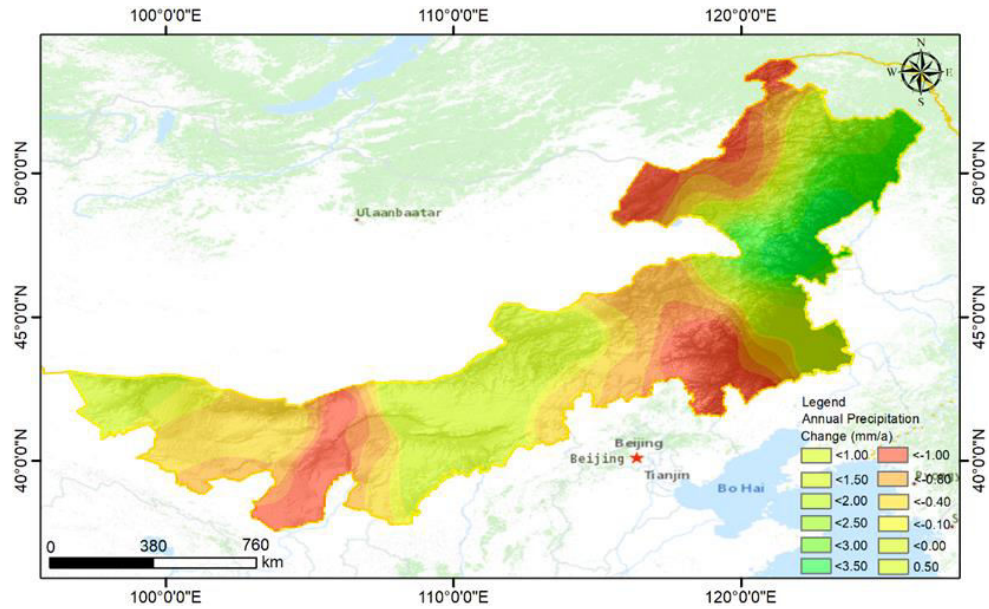
Potential impact on Water Balance



$$\text{Water Balance} : Q = P - E_{ta} - \Delta S$$

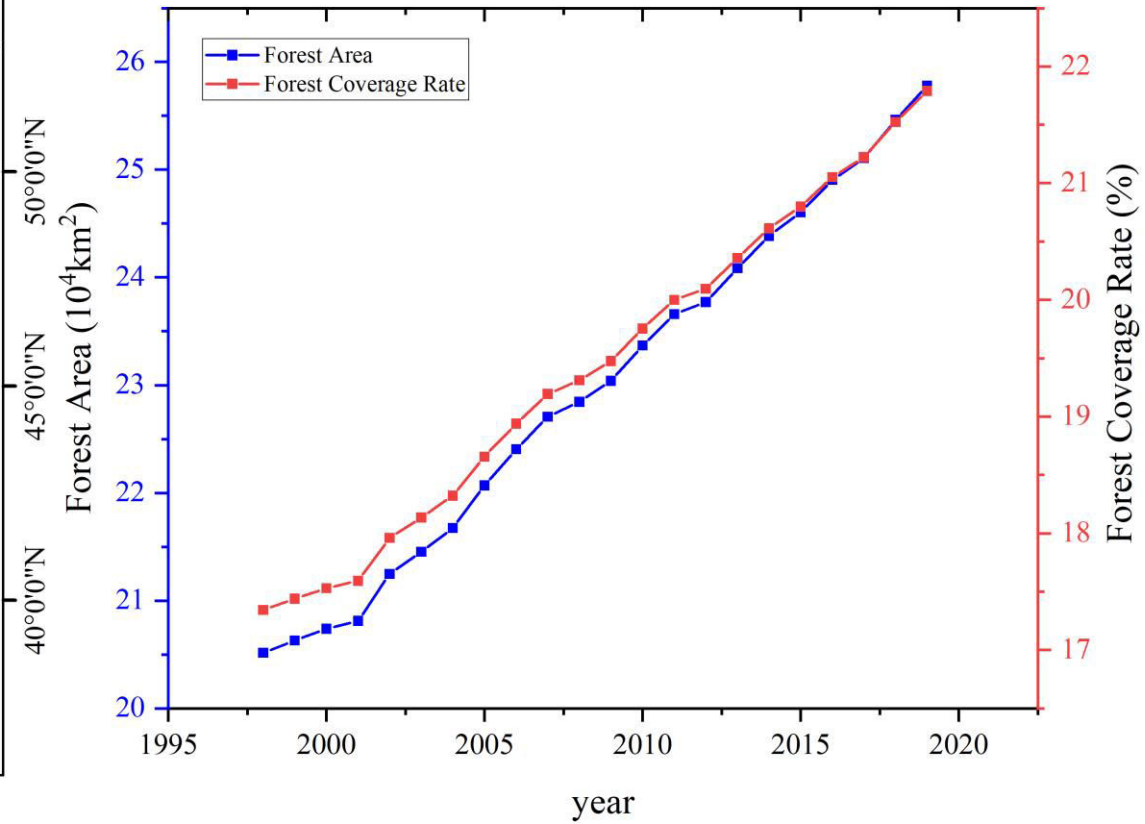
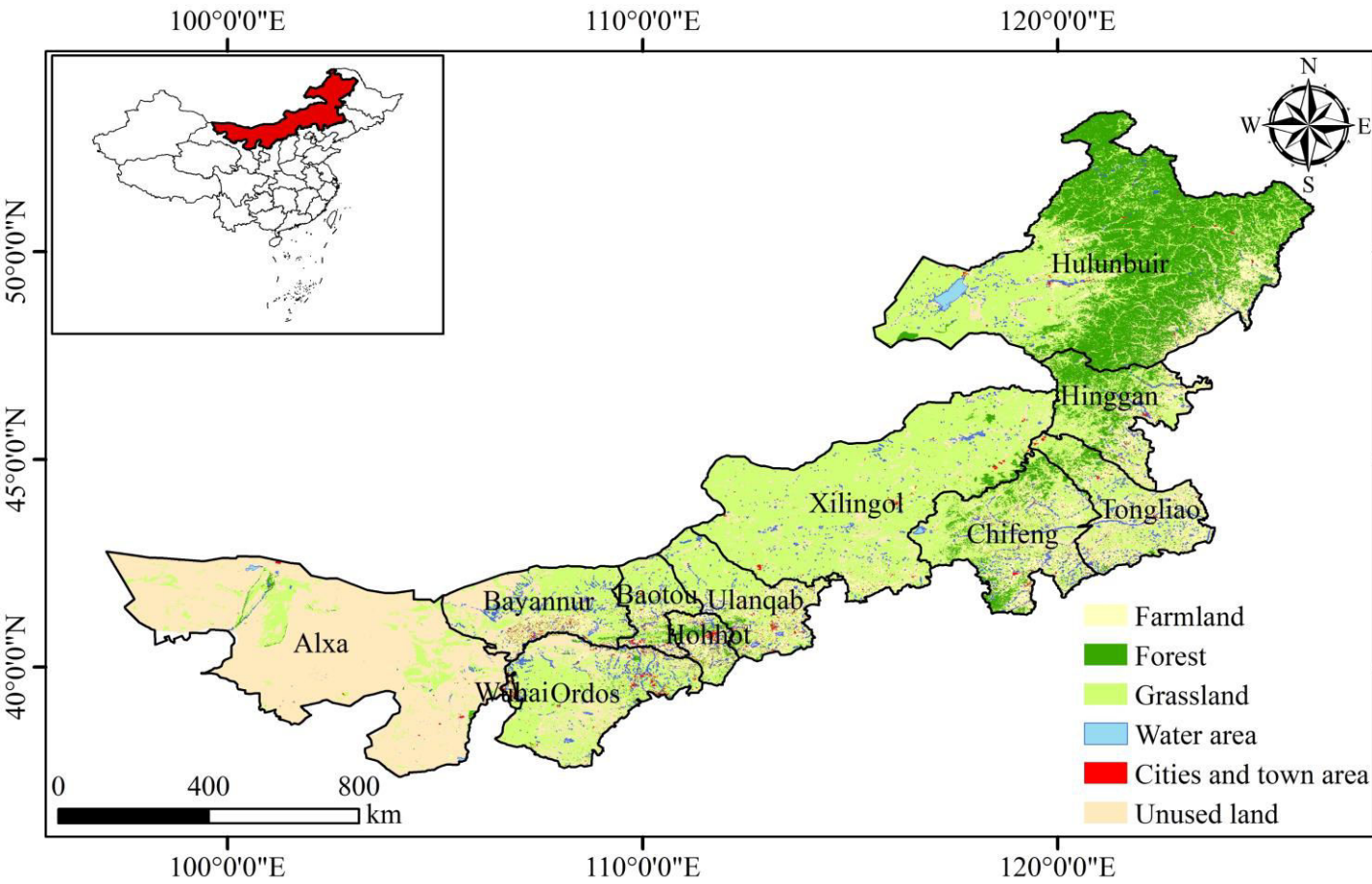


Variations of Climate in Inner Mongolia Plateau



Variations of Forest Land in Inner Mongolia Plateau

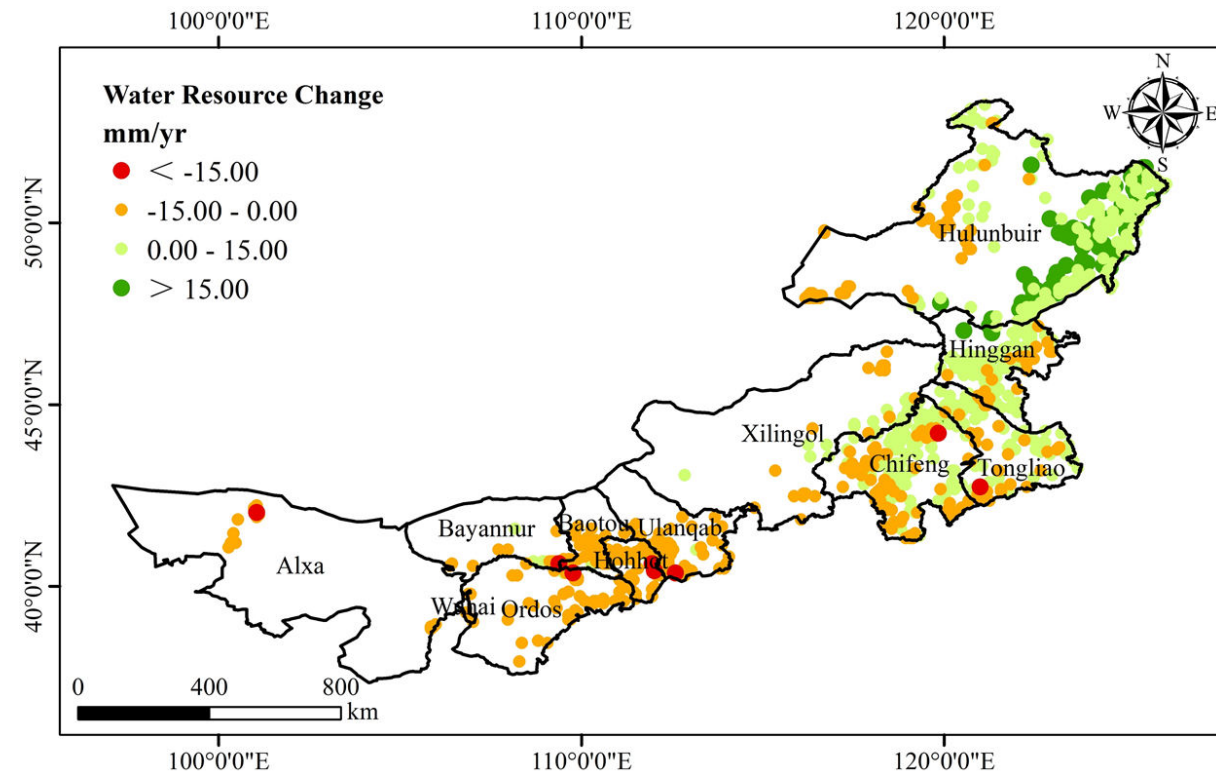
- The forest coverage rate in China increased from 12%~ to 23%~ in 1962-2018
- Inner Mongolia forest area covers 14%~ of China
- The forest coverage rate in Inner Mongolia increased from 18%~ to 22%~ in 2000-2020
- The afforestation area in Inner Mongolia was $5.37 \times 10^4 \text{ km}^2$ in 2000-2020



Ecological Risks Arising for the Afforestation

Water Balance

ET : Artificial forest > Natural forest

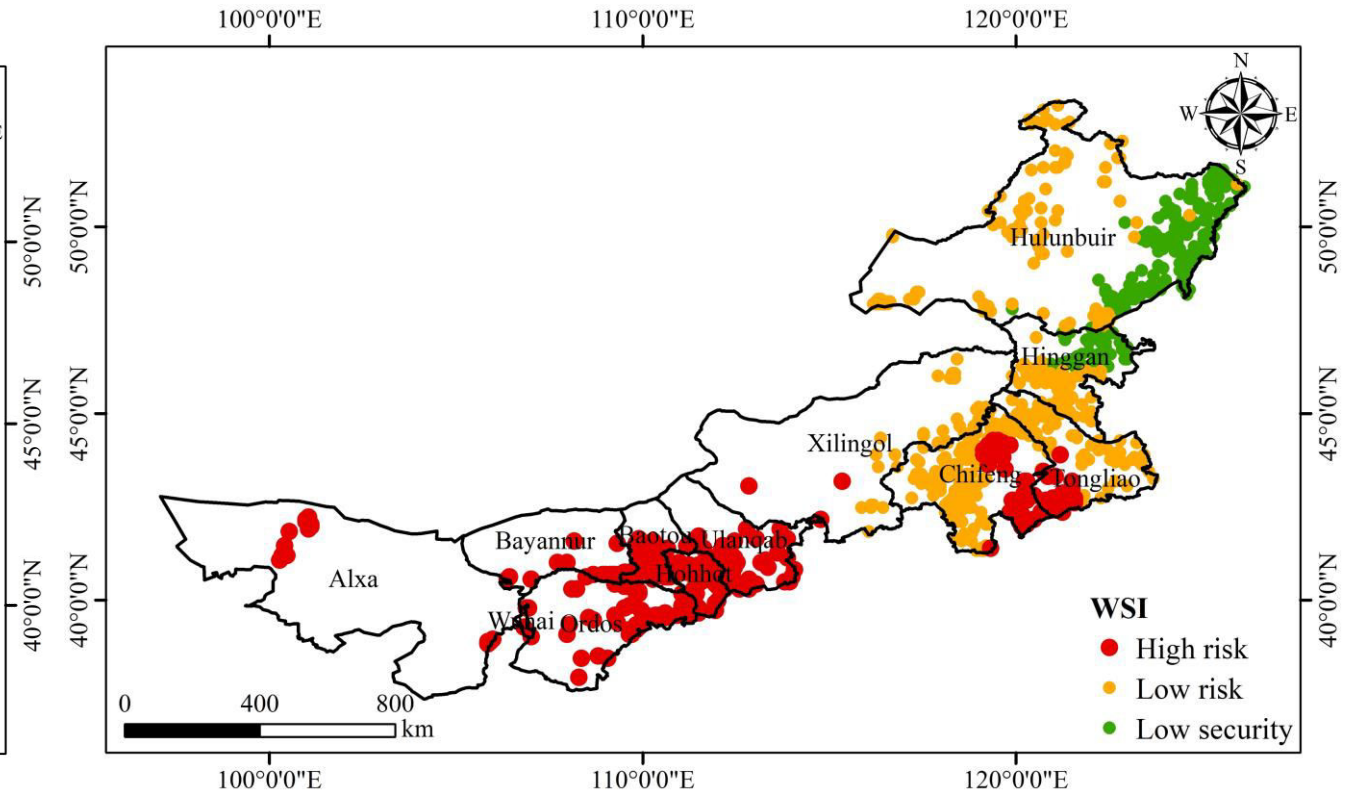


Ecological risk

Water Resource Safety Index:

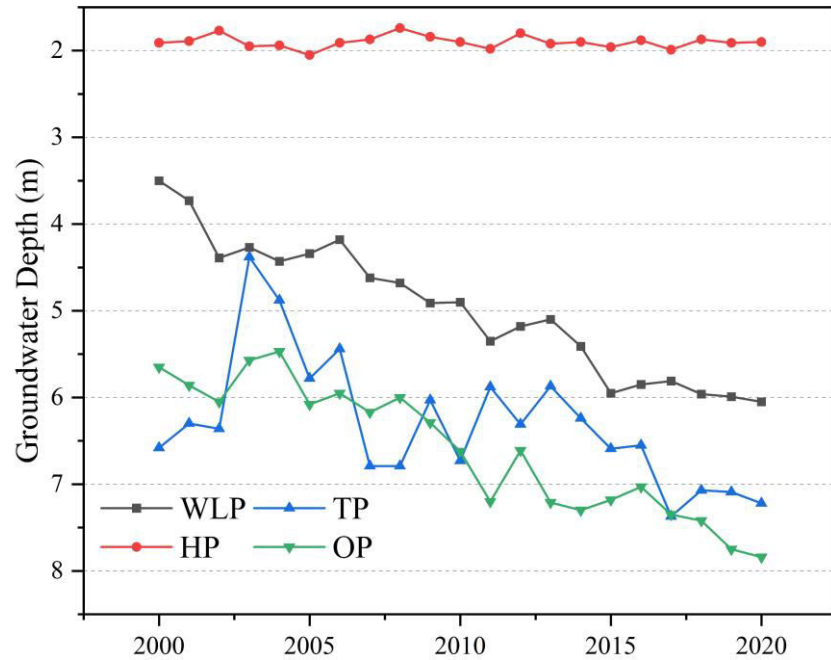
$$WSI = \lg\left(\frac{\text{water supply}}{\text{ecological water requirement}}\right)$$

Hypothesis : only precipitation supply

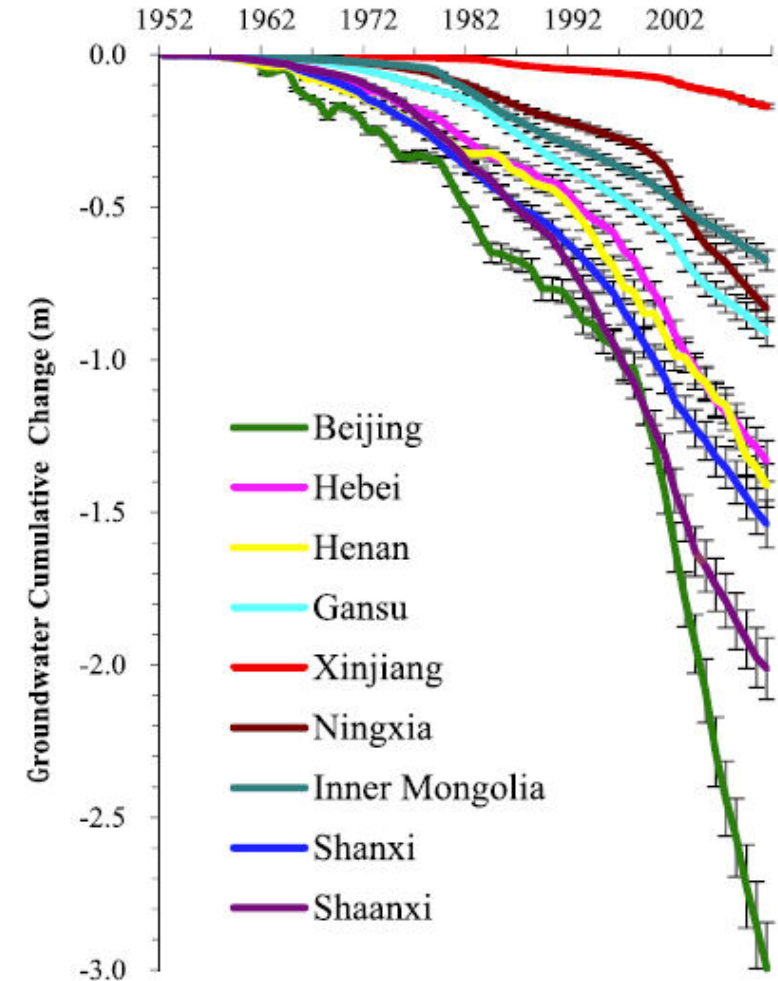


Variations of Groundwater in Inner Mongolia

Shallow Groundwater Depth



West Liaohe Plain-WLP
Hetao Plain-HP
Tumochuan Plain-TP
Ordos Plain-OP



(Lu et al., 2018 J. Clean. Prod)

Future Ecological Risks to Afforestation



标 题: 国家发展改革委 自然资源部关于印发《全国重要生态系统保护和修复重大工程总体规划(2021-2035年)》的通知
发文字号: 发改农经〔2020〕837号
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主题分类: 城乡建设、环境保护\环境监测、保护与治理
公文种类: 通知
发文机关: 发展改革委 自然资源部
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国家发展改革委 自然资源部关于印发 《全国重要生态系统保护和修复重大工程 总体规划(2021-2035年)》的通知

发改农经〔2020〕837号

国务院有关部门,各省、自治区、直辖市、新疆生产建设兵团发展改革委、自然资源主管部门:

《全国重要生态系统保护和修复重大工程总体规划(2021-2035年)》已经中央全面深化改革委员会第十三次会议审议通过,现印发你们,请认真贯彻落实。

国家发展改革委
自然资源部
2020年6月3日

附件:《全国重要生态系统保护和修复重大工程总体规划(2021-2035年)》

- Void afforestation in arid and semi-arid areas
- A wetter climate in the future may mitigate the ecological risks posed by afforestation

“Carbon peak and Carbon neutrality”

“Striving achieve 26% of the country's forest coverage by 2035”

Conclusion



- The afforestation area in Inner Mongolia was $5.37 \times 10^4 \text{ km}^2$ in 2000-2020
- Afforestation in arid and semi-arid areas leads to the reduction of water resources.
- Afforestation reduces water resources in the study area by $0.76 \times 10^8 \text{ m}^3/\text{year}$
- ~30% of afforestation areas are high risk, ~45% low risk and ~25% low security

THANK YOU

