Large-scale reforestation can increase water yield and reduce drought risk for water-insecure regions in the Asia-Pacific

NUS National University of Singapore | Centre for Nature-based Climate Solutions, Faculty of Science

Hoong Chen Teo, Srivatsan V. Raghavan, Xiaogang He, Zhenzhong Zeng, Yanyan Cheng, Xiangzhong Luo, Alex M. Lechner, Matthew J. Ashfold, Aakash Lamba, Rachakonda Sreekar, Qiming Zheng, Anping Chen, Lian Pin Koh

Talk to me ☺
hcteo@u.nus.edu
@hcteohc

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1. Introduction

Reforestation is perceived as a low-risk nature-based solution (NbS), delivering many potential socio-ecological benefits.

But, reforestation can have complex hydrological impacts, because forests can both consume and supply water:

Demand-side

Supply-side

After reforestation, both increases/decreases in water yield (precipitation minus evapotranspiration) have been documented.

Many water basins face water insecurity under future climates – will reforestation be a beneficial or risky NbS for them?

2. Methods

(a) Identify projected water-insecure basins sensitive to water yield changes globally.
- Scenario: basins where potentially reforestable area > 10%. All reforestation potential becomes forest by ~2040. Simulations for 2040s, 2050s and 2060s.
- Criteria: water-stressed basins, dryland basins, and/or water yield projected to decline by > 5%.

(b) Regional climate modelling of water-insecure regions.
- Downscale RCP4.5 GCM outputs for 2040-2070 using RegCM4.7-CLM4.5, 40 km resolution.
- Compare runs using CLM4.5 default land cover (baseline) with reforestation potential fulfilled (treatment).

3. Projected water-insecure basins in reforestation potential areas

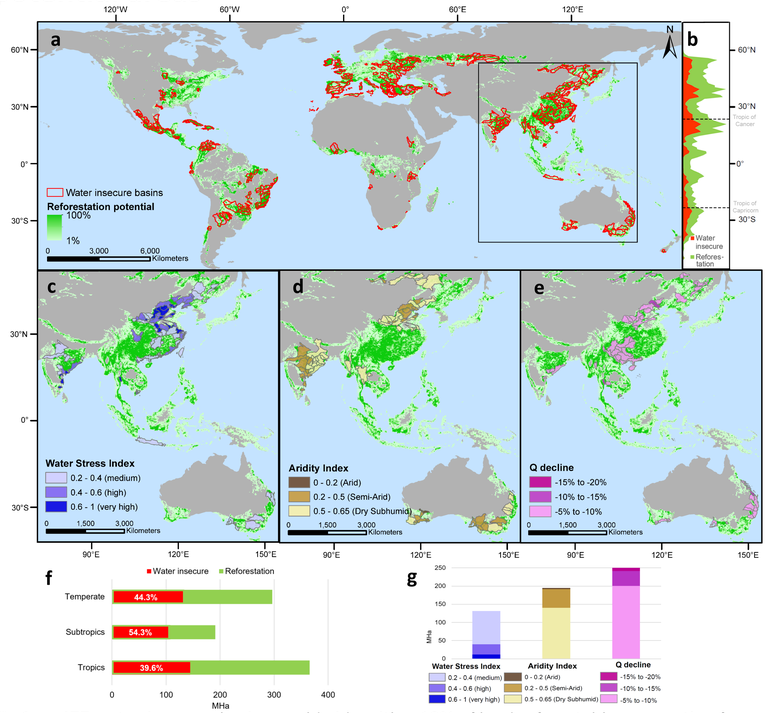

Fig 1. a, 477 water-insecure basins worldwide with > 10% of land reforestable, accounting for 44.6% (380.2 Mha) of the global reforestation potential.

5. Key findings

- Reforestation can lead to **positive hydrological effects**, such as **increases in water yield, precipitation, soil moisture**, and **reductions in drought risk**.
- Reforestation was assessed to be **hydrologically beneficial** to water yield in **7 out of 15** water-insecure regions with medium to high confidence. This was statistically significant ($p < 0.05$) for the **Loess Plateau-North China Plain, Yangtze Plain, Southeast China and Irrawaddy** regions. These 7 water-insecure regions are home to **928 million people**, out of 1.3 billion people living in water-insecure regions across the Asia-Pacific in 2020.
- However, some regions experience non-significant declines in net water yield due to heightened evapotranspiration outstripping increases in precipitation, or declines in soil moisture and advected precipitation.

4. Modelling the hydrological impacts of reforestation on water-insecure regions

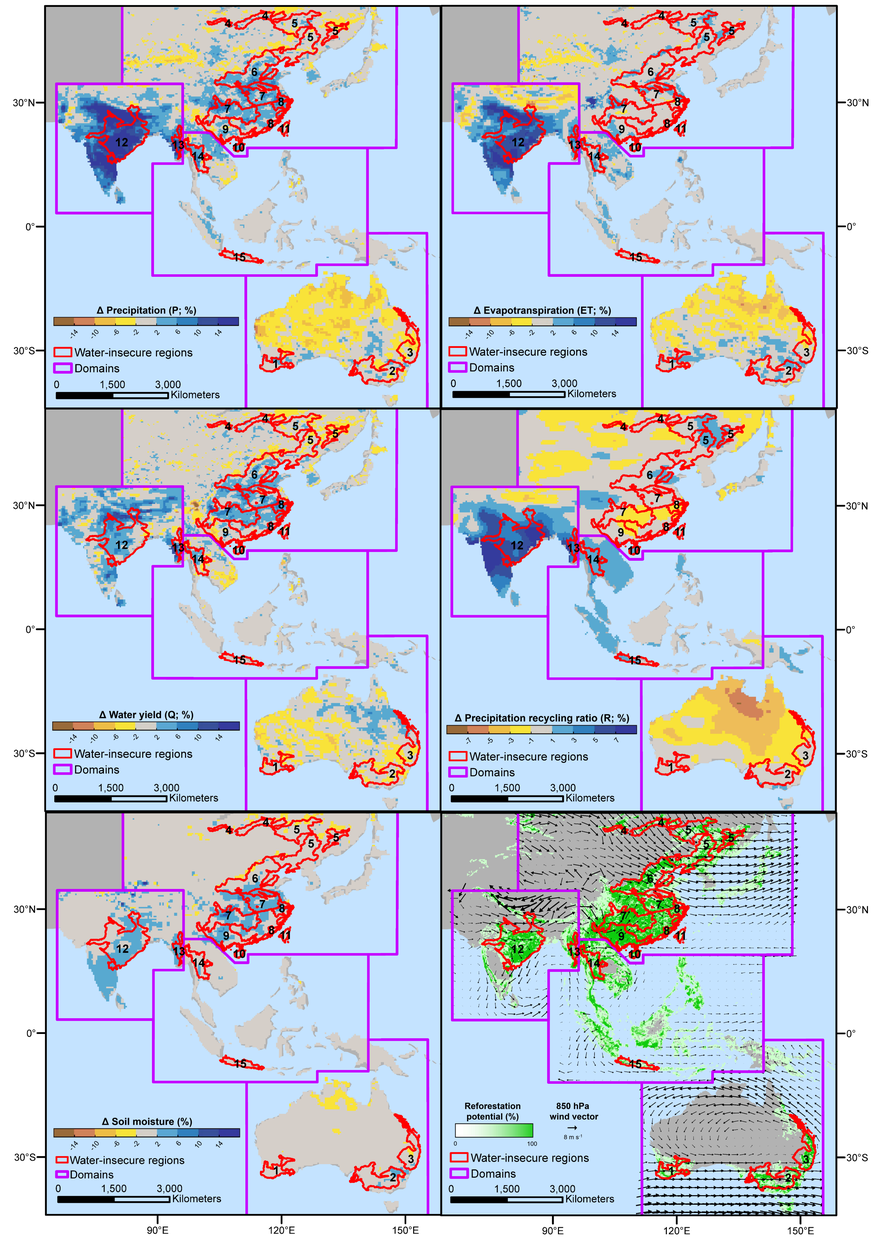

Fig 2 Climatic changes simulated by regional climate modelling between 2041 and 2070 in the Asia-Pacific, due to fully realising reforestation potential by 2040.