Land condition and management options in China drylands

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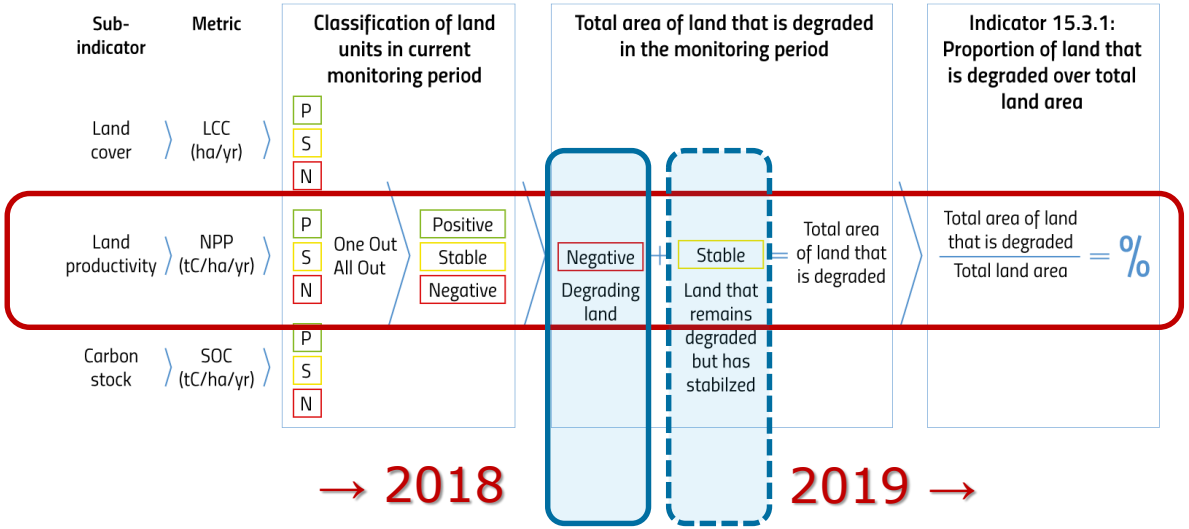
International context

- UNDP Sustainable Development Goals (SDG)
  - *universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity*
  - *17 Goals covering multiple facets of human life*
- Goal 15, Target 3
  - *By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world*
  - *UNCCD: custodian agency (← CBD, UNFCCC, UNEP)*
- SDG indicator 15.3.1:
  - *Proportion of land that is degraded over total land area*

Project context

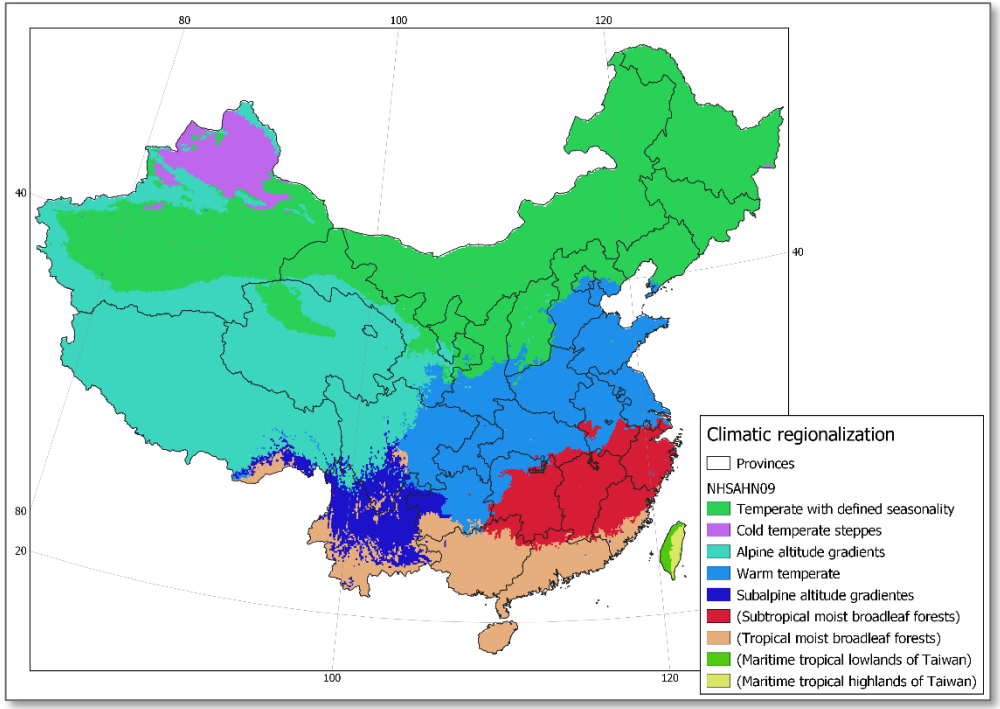
- SDG indicator 15.3.1 sub-indicators
  - *land cover change targets at reduction or increase in vegetation*
  - *land productivity captures relatively fast changes in "greeneness"*
  - *carbon stocks reflects slower changes in the condition of land resources*



Project 32396

This study

- **Hypothesis**
  - Land condition and land use maintain interactive feedbacks that control land management options
- **Domain**
  - This trial: temperate zone with defined seasonality of N China (Dragon 3 outcome)
  - Target: Potential Extent of Desertification in China (Sun, B. et al. 2015)
- **Data**
  - Climate: China Meteorological Forcing Dataset (Chen, Y. et al. 2011)
  - NPP: archived time-series ← CASA (ESA Envisat-MERIS) (Gao et al. 2014)
  - Land cover: 38 FAO LCCS-based classes (Zhang et al., 2014)
  - Land condition: 2dRUE-based assessment of land condition states (del Barrio et al 2016)
- **Methods**
  - Statistical analysis stratified by aridity zones: associations by chi-square, Ranks mean test, Tukey's Unequal N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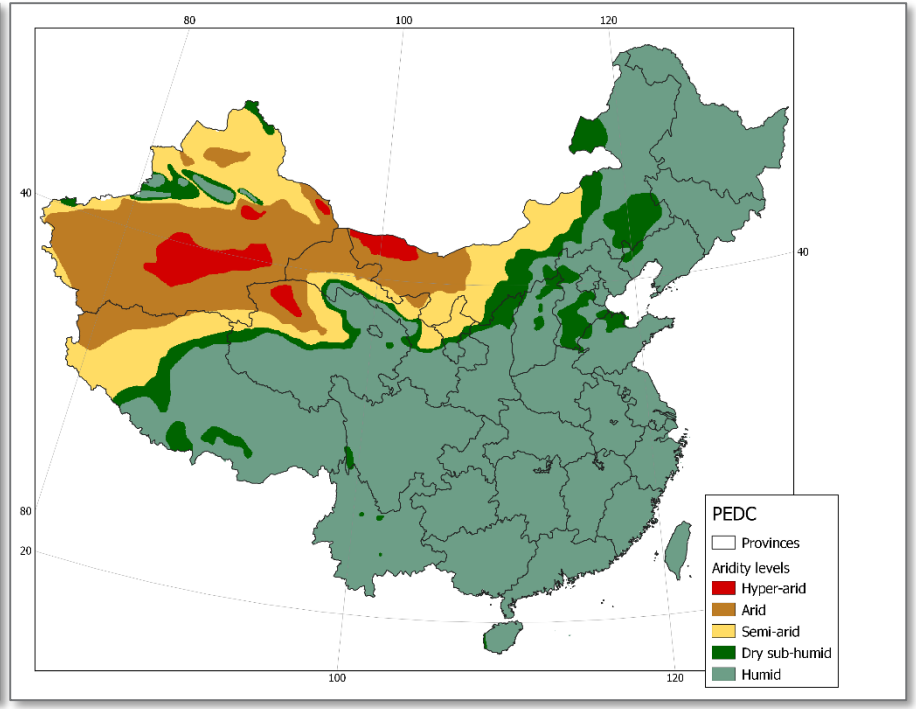
Climatic regionalization
Provinces
NHSAHN09
Temperate with defined seasonality
Cold temperate steppes
Alpine altitude gradients
Warm temperate
Subalpine altitude gradientes
(Subtropical moist broadleaf forests)
(Tropical moist broadleaf forests)
(Maritime tropical lowlands of Taiwan)
(Maritime tropical highlands of Taiwan)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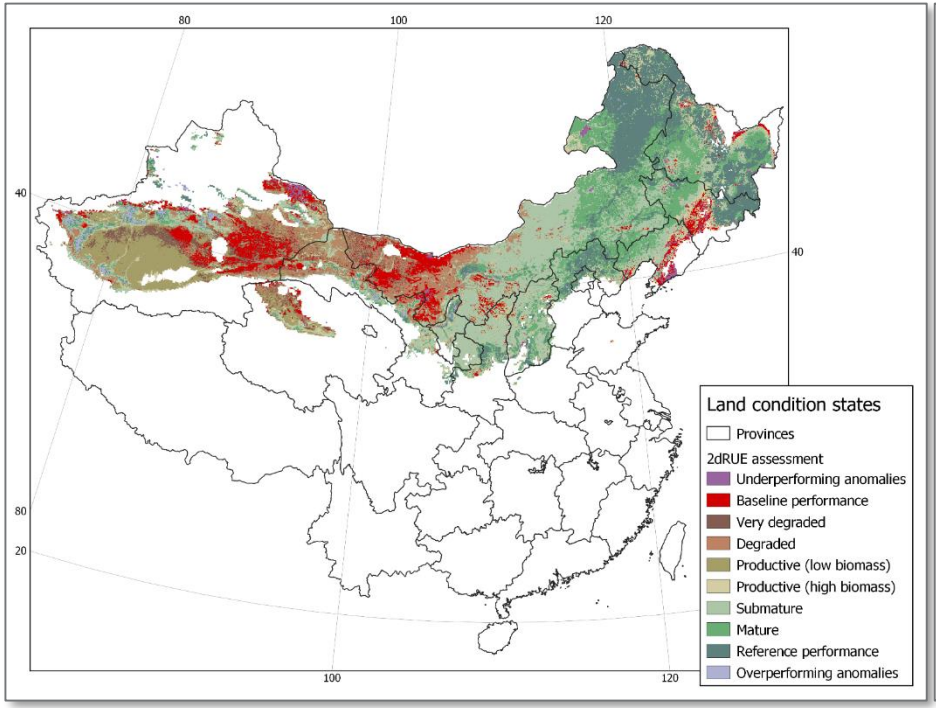
PEDC
Provinces
Aridity levels
Hyper-arid
Arid
Semi-arid
Dry sub-humid
Humid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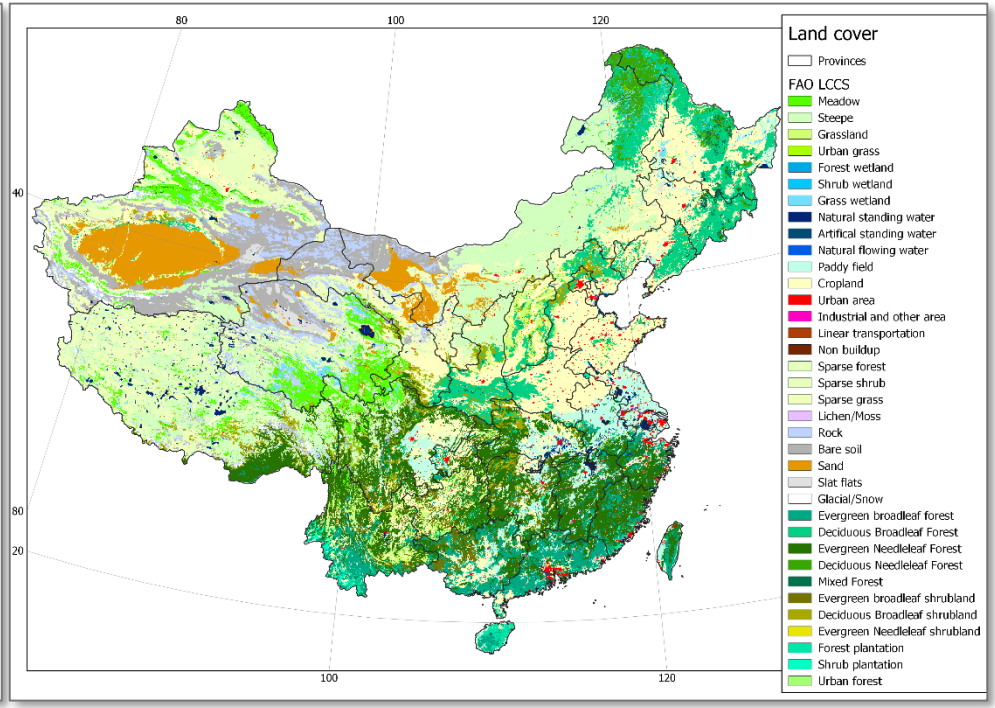
Land condition states
Provinces
2dRUE assessment
Underperforming anomalies
Baseline performance
Very degraded
Degraded
Productive (low biomass)
Productive (high biomass)
Submature
Mature
Reference performance
Overperforming anomalies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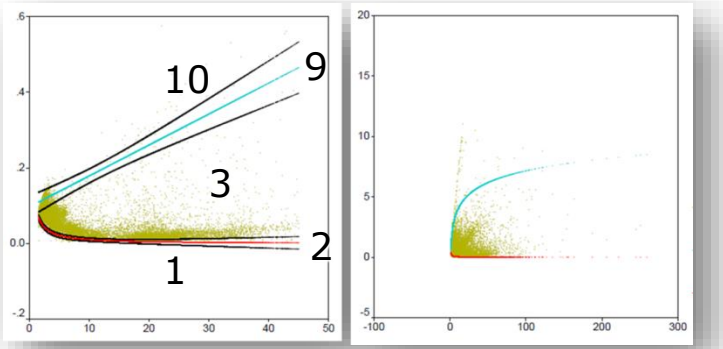
Land cover
Provinces
FAO LCCS
Meadow
Steepe
Grassland
Urban grass
Forest wetland
Shrub wetland
Grass wetland
Natural standing water
Artifical standing water
Natural flowing water
Paddy field
Cropland
Urban area
Industrial and other area
Linear transportation
Non buildup
Sparse forest
Sparse shrub
Sparse grass
Lichen/Moss
Rock
Bare soil
Sand
Slat flats
Glacial/Snow
Evergreen broadleaf forest
Deciduous Broadleaf Forest
Evergreen Needleleaf Forest
Deciduous Needleleaf Forest
Mixed Forest
Evergreen broadleaf shrubland
Deciduous Broadleaf shrubland
Evergreen Needleleaf shrubland
Forest plantation
Shrub plantation
Urban forest

2dRUE land states: legend system

Observed RUE vs. Aridity:



rRUEme *rRUEex*

'Annual mean biomass and NPP are expected to decrease with land degradation, whilst peak NPP is at its maximum at intermediate degradation states' (Pickup *et al.* 1994)

$$Turnover = \frac{PRODUCTIVITY}{BIOMASS} \approx \frac{rRUEex}{rRUEme}$$

1. **Underperforming anomaly**
2. **Baseline performance**

Range

9. **Reference performance**
10. **Overperforming anomaly**

	Turnover	Biomass	State
3	high	low	**Very degraded**
4	low	low	**Degraded**
5	high	medium	**Prod. with low biomass**
6	high	high	**Prod. with high biomass**
7	low	medium	**Submature**
8	low	high	**Mature**

System exergy (potential)

LC 2010 in DRY SUB-HUMID	rank mean	3	1	2	5	4

LC 2010 in SEMI-ARID	rank mean	3	4	1	2

LC 2010 in ARID	rank mean	1	2	6	5	4	3
Cropland	4470	****					
Forest plantation	4391	****	****				
Deciduous Broadleaf Forest	4036	****					
Meadow	3972	****	****				
Deciduous Broadleaf shrubland	3966	****					
Sparse shrub	3204		****				
Steppe	2999		****	****			
Sparse grass	2614			****	****		
Salt flats	2457			****	****		
Sand	2080				****		
Rock	1863					****	
Bare soil	1820					****	

Postulates:

1. Vertical: plausible path of management options.
2. Stepping down (i.e. degrading land condition) is easier than going upwards.
3. Efficient land use changes occur between classes at the same condition level.
4. Transitions between land uses may have bottlenecks.
5. Management options are proportional to the level in staircase.

Concluding remarks

- **Preliminary conclusions**
  - Land condition and land use have concrete relationships that control land management options
  - The concrete staircase pattern of a region conveys suitable land use changes
  - Land degradation means loss of management options
    - Corolary: Land degradation policy could target at maximizing management options
- **Next steps**
  - Extend the analysis to PEDC
  - Focus on LC classes reflecting land use
  - Quantify and map management options in terms of degrees of freedom
  - Align indicator with SDG 15.3.1