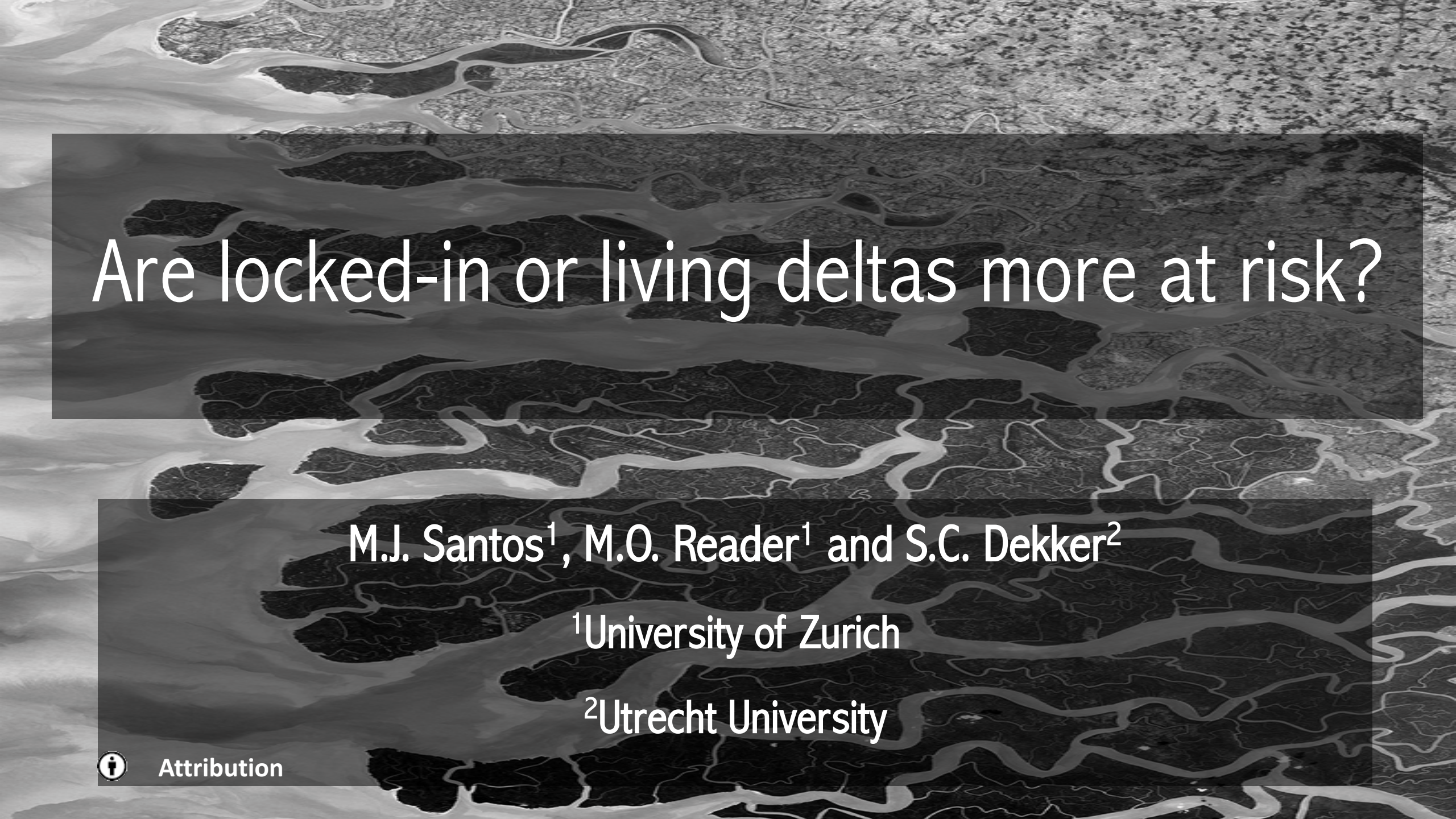

Are locked-in or living deltas more at risk?

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Deltas at Risk

Deltas are important and at risk because:

- Hold a large fraction of our global population
- Land use changes (Temmerman et al. 2015), and water extraction
- Increased land subsidence (Mazzotti 2009)
- Accumulate pollution from upstream sources
- Highly vulnerable to sea level rise, floods and droughts (Syvitski et al 2009)
- Supply many nature's contributions to people

"The current emphasis on short-term solutions for the world's deltas will greatly constrain options for designing sustainable solutions in the long term" (Tessler et al. 2015)

Delta Locked-in

Past changes could have lead delta systems to become locked-in, i.e. unable or too costly to recover, in turn resulting in higher risks that those deltas are currently facing

Over time:

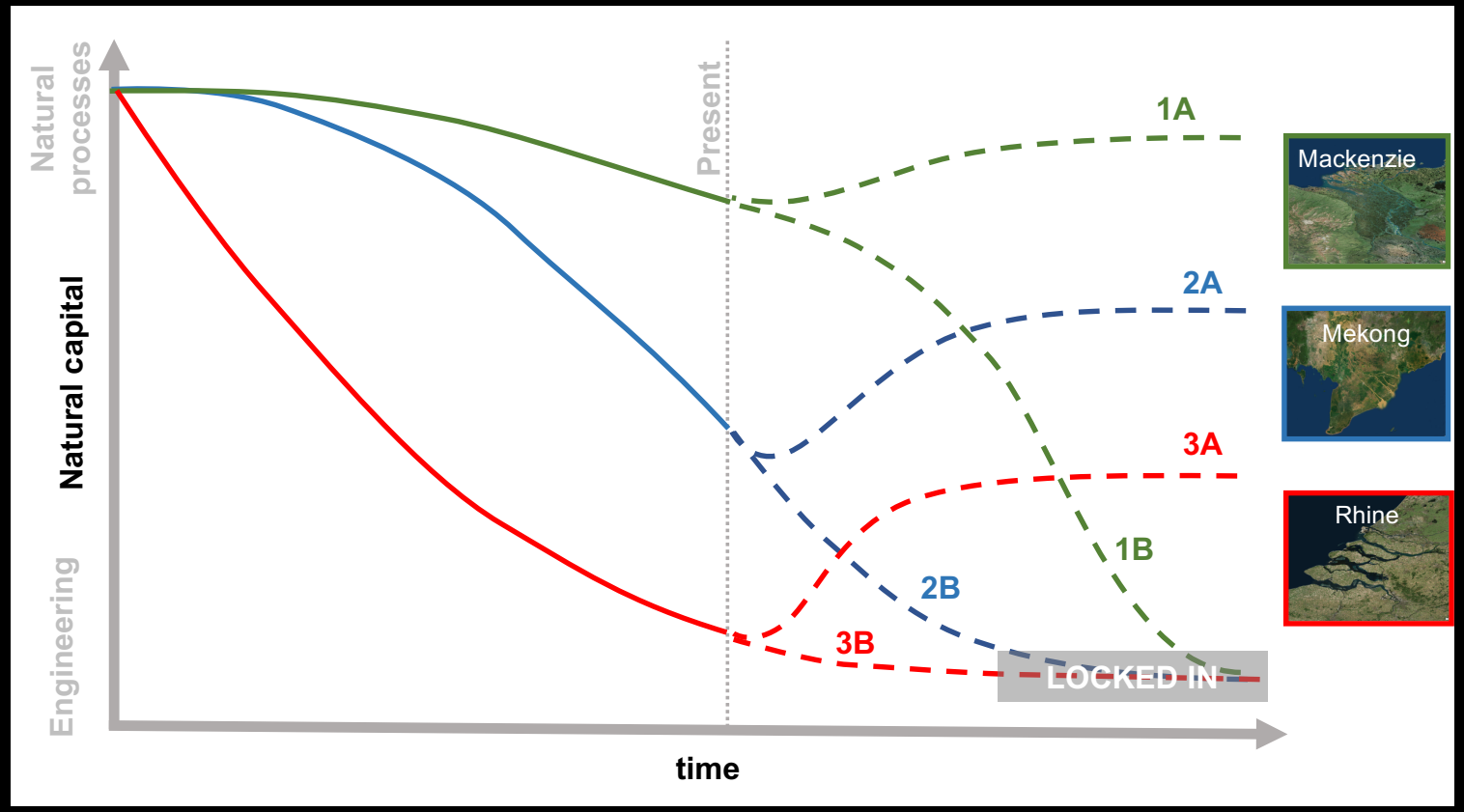
Population ⬆

Cropland ⬆

Irrigated land ⬆

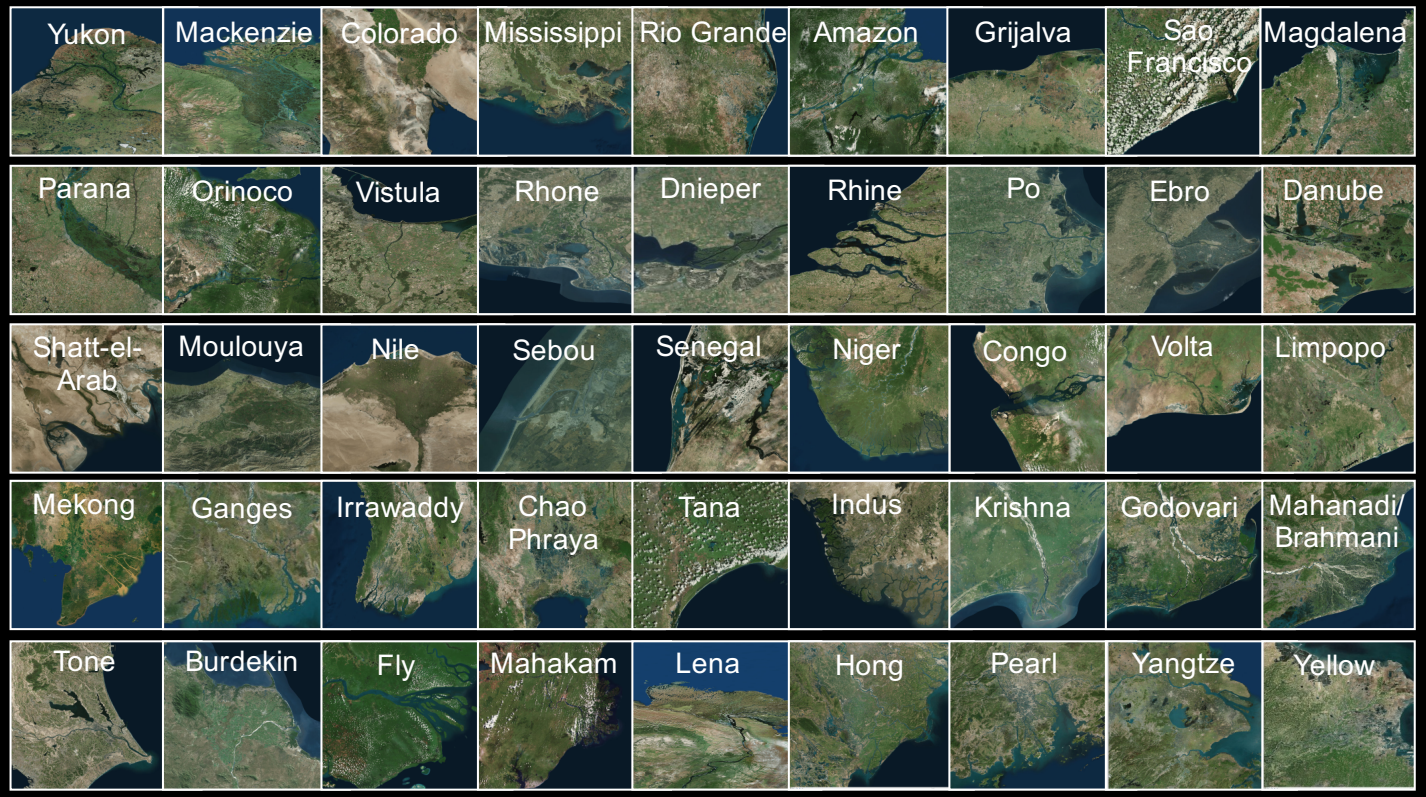
Locked-in when:

Lack of correlation between population, cropland and irrigation development



Methods - Delta Development

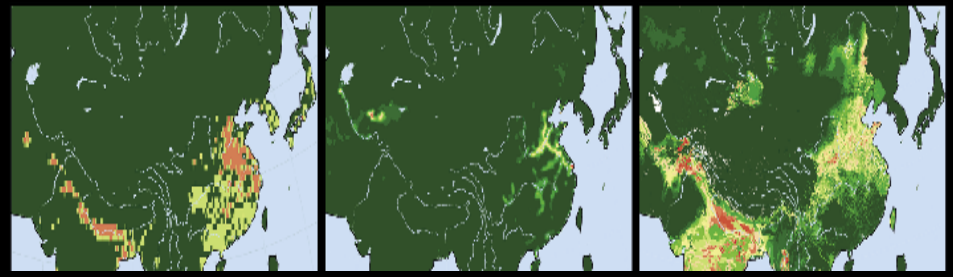
Reconstruct the development of population and land use (crop and irrigation) in 48 major deltas over the last 310 years



Data sources

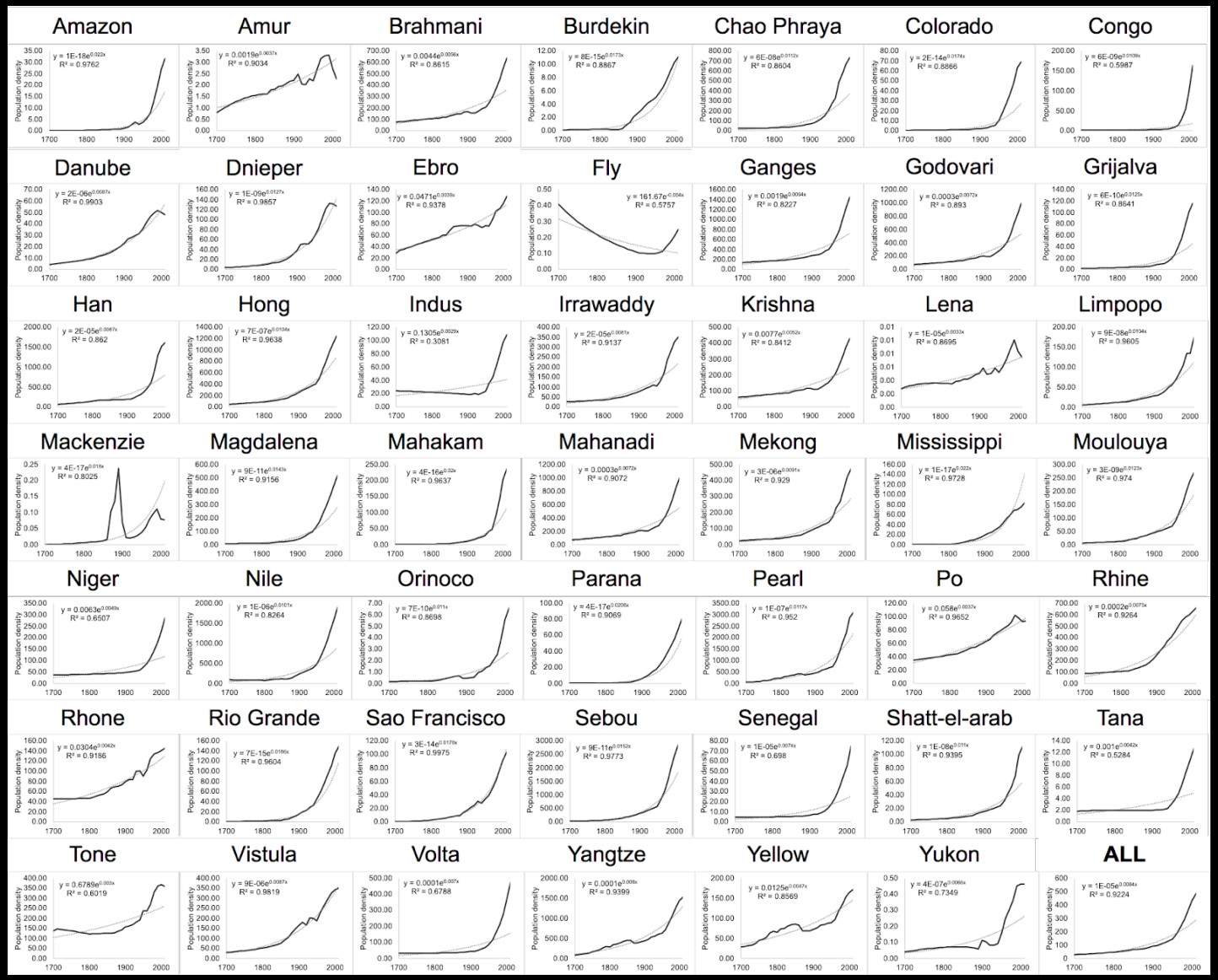
- HYDE 3.2.
  History Database of the Global Environment (http://themasites.pbl.nl/tridion/en/themasites/hyde/)

- Gridded (~10km) estimates of LUC and Population density over the Holocene



Results - Delta Development

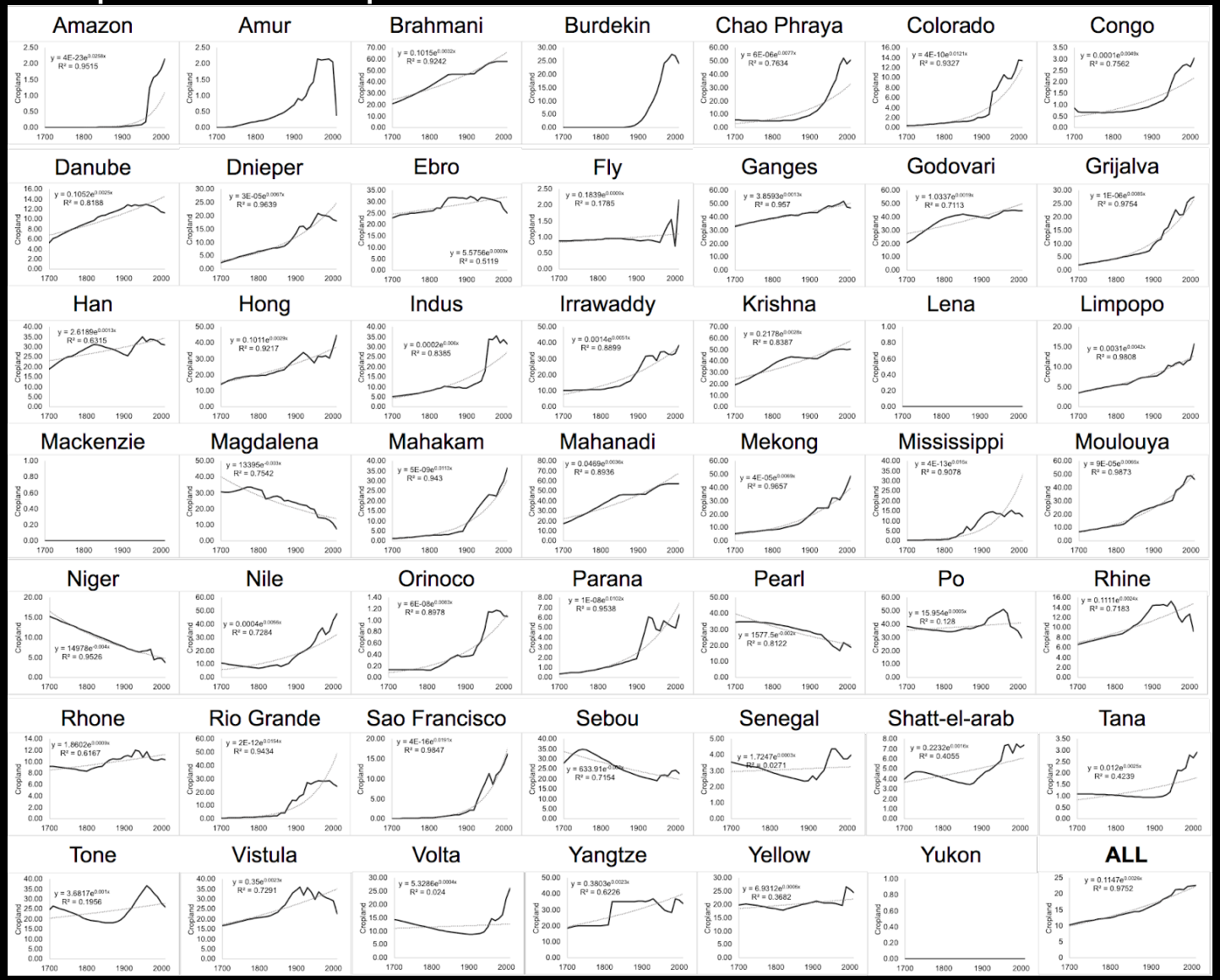
Population development



- Population development is faster in deltas than in other areas
- Mainly in deltas between -10 to 0 degrees latitude

Results - Delta Development

Cropland development



- Cropland development is higher in deltas between -20 and 0 degrees latitude
- Irrigated areas in deltas are highest at 20 degrees latitude

Methods - Delta Lock-in

Three types of lock-in:

Living delta (1A):

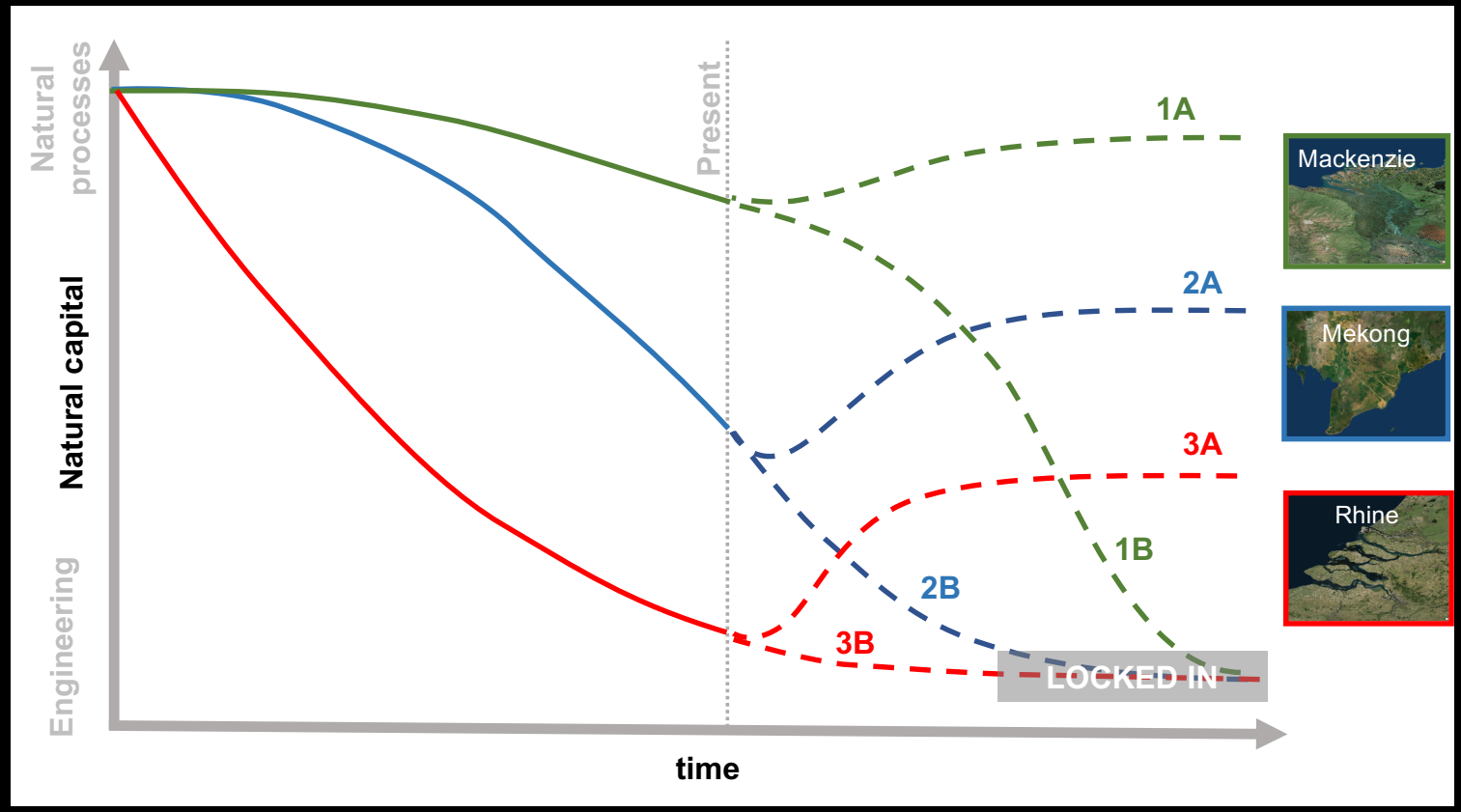
no lock-in (correlation between population, cropland and irrigation development)

Natural Lock-in (2A):

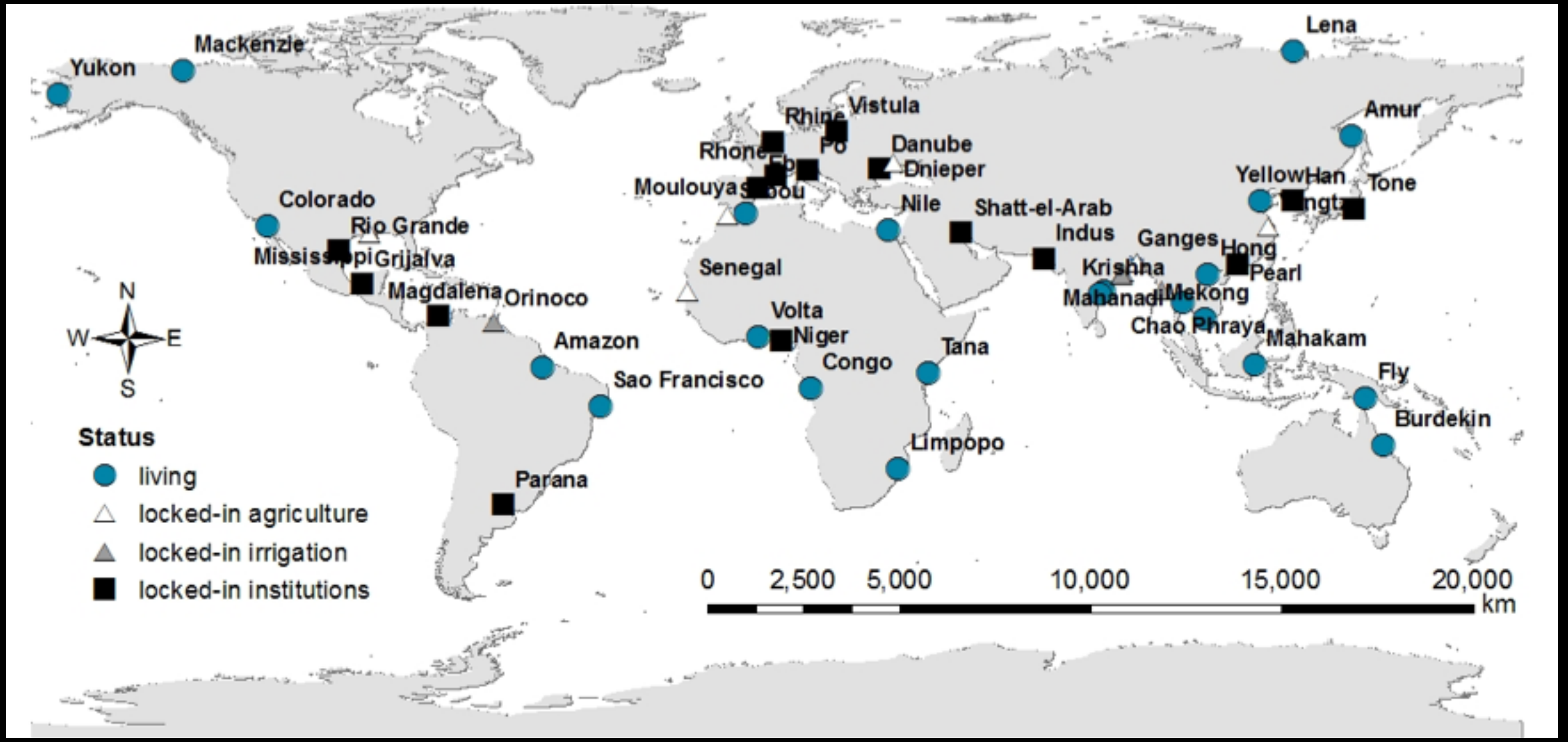
crop or irrigation (lack of correlation between population, and cropland and irrigation development)

Social Lock-in (3A):

population development (negative correlation between population, and cropland and irrigation development)



Results - Delta Lock-in



Methods - Deltas at Risk

Three types of lock-in:

Living delta

Natural Lock-in - crop

Natural Lock-in - irrigation

Social Lock-in

Deltas at Risk of:

1. Overall Risk (R):

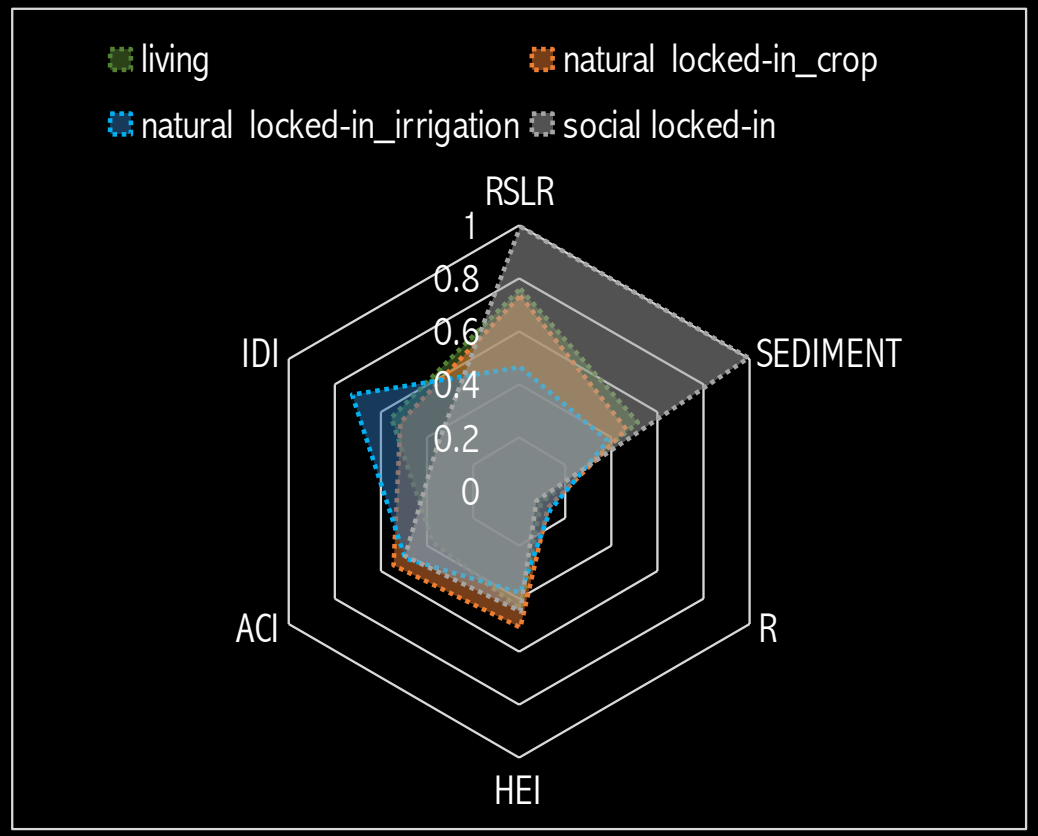
a combination of

- hazardous events (HEI)
- anthropogenic conditioning (ACI)
  - number of people exposed to hazardous conditions
- investment deficit (IDI)
  - total investment needed for delta to be resilient

2. Relative Sea Level Rise (RSLR)

Results - Deltas at Risk

Crop and Social lock-in deltas have higher risk

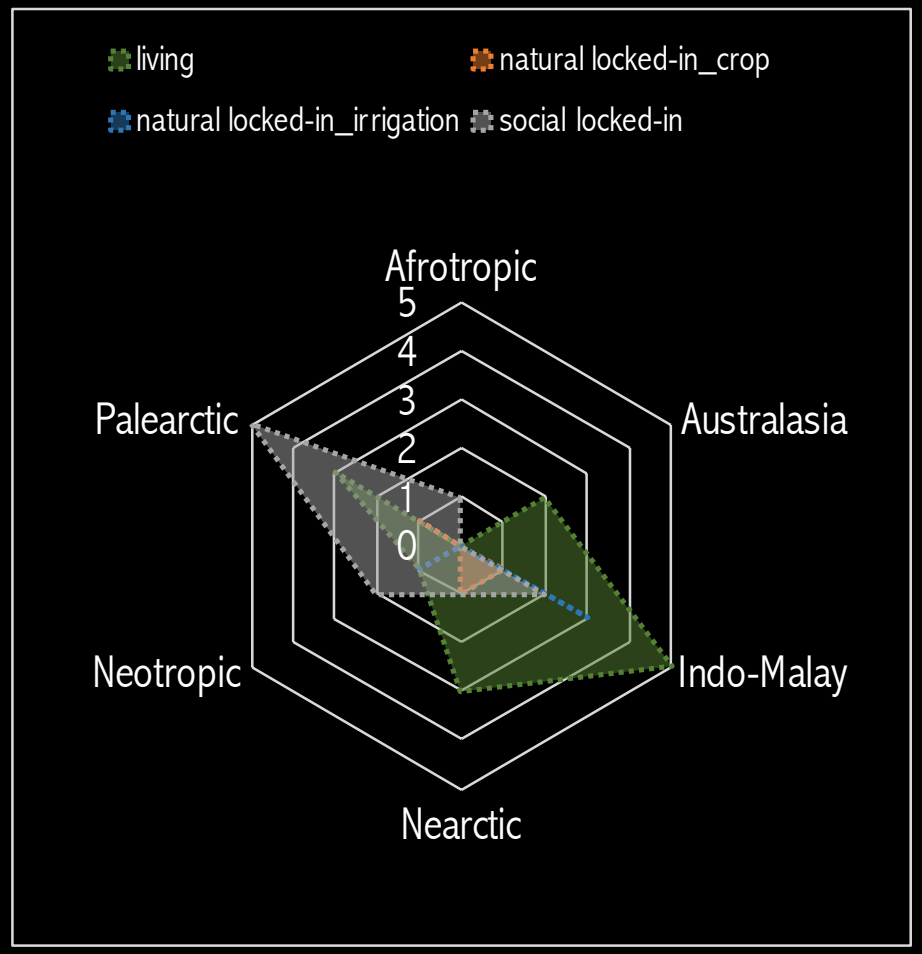


Delta state	R	HEI	ACI	IDI	RSLR (mm/yr)
Living	0.09	0.44	0.38	0.60	6.7(5.3)
Natural lock-in (crop)	0.13	0.51	0.55	0.52	6.4(2.8)
Natural lock-in (irrigation)	0.14	0.38	0.50	0.73	4.1(0.6)
Social lock-in	0.07	0.45	0.49	0.35	8.7(5.9)

Red indicates higher risk

Methods – Delta supply of NCPs

Delta status by biome



Status may affect
Supply of nature's contributions to people

Food
- Food area
- Attainable yield
- Pasture area
- Aquaculture
- Fish river
- Fish marine
- Forest cover
- Oil area

Water
- Water withdrawal
- Water available
- Discharge
- Water quality deficit

Carbon veg
- Carbon vegetation
- Carbon veg potential
- NPP potential
- NPP actual

Biodiversity
- Intactedness
- Marine plant richness
- Marine animal richness
- Plant richness
- Amphibian richness
- Bird richness
- Seabird richness
- Mammal richness

Pollination+ Invasives
- Pollination supply
- Pollination deficit
- IAS

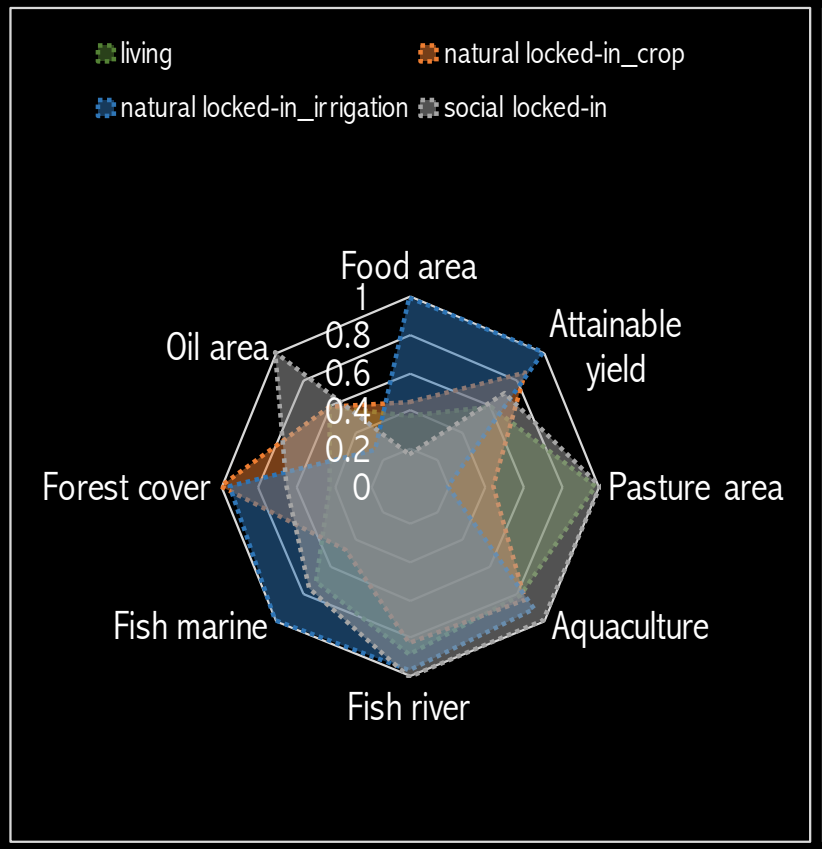
Soil
- Carbon soil
- Soil water
- Nitrogen need
- Phosphorus need
- Workability
- Loss

Used maps of existing NCPs produced at the global level

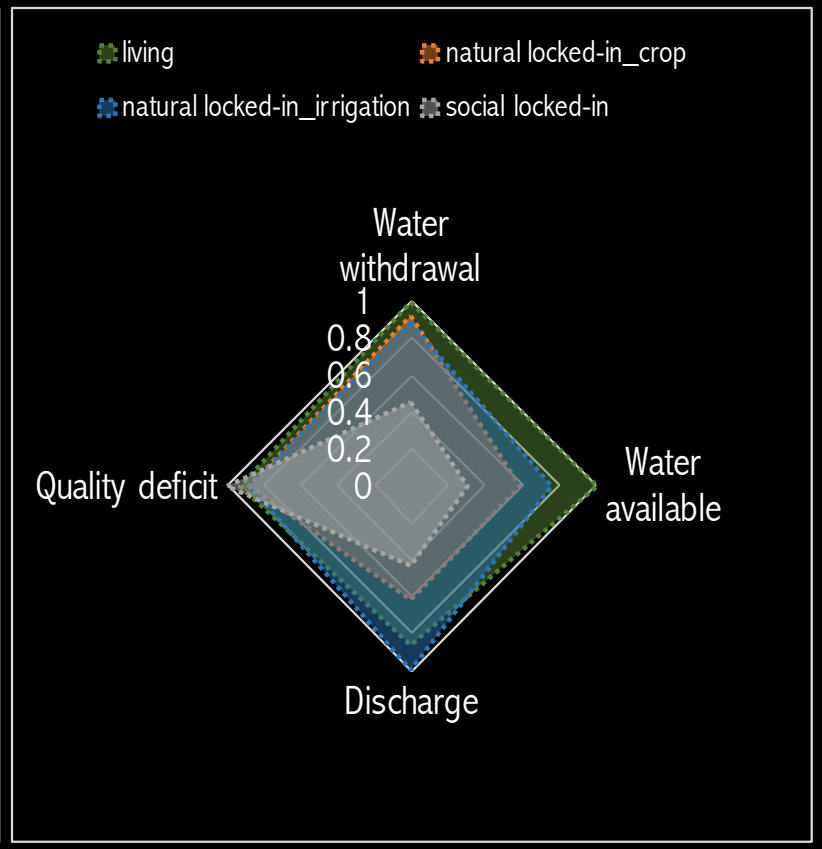
Results – Delta supply of NCPs

- Living deltas supply the most NCPs
- Irrigation and social locked-in have the most food

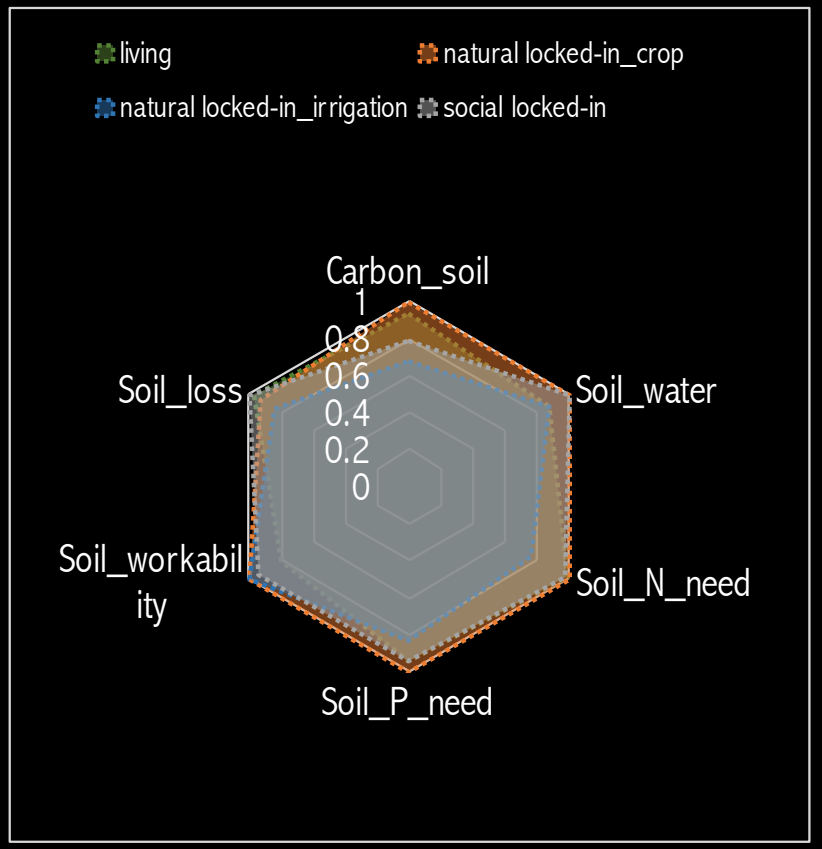
Food



Water



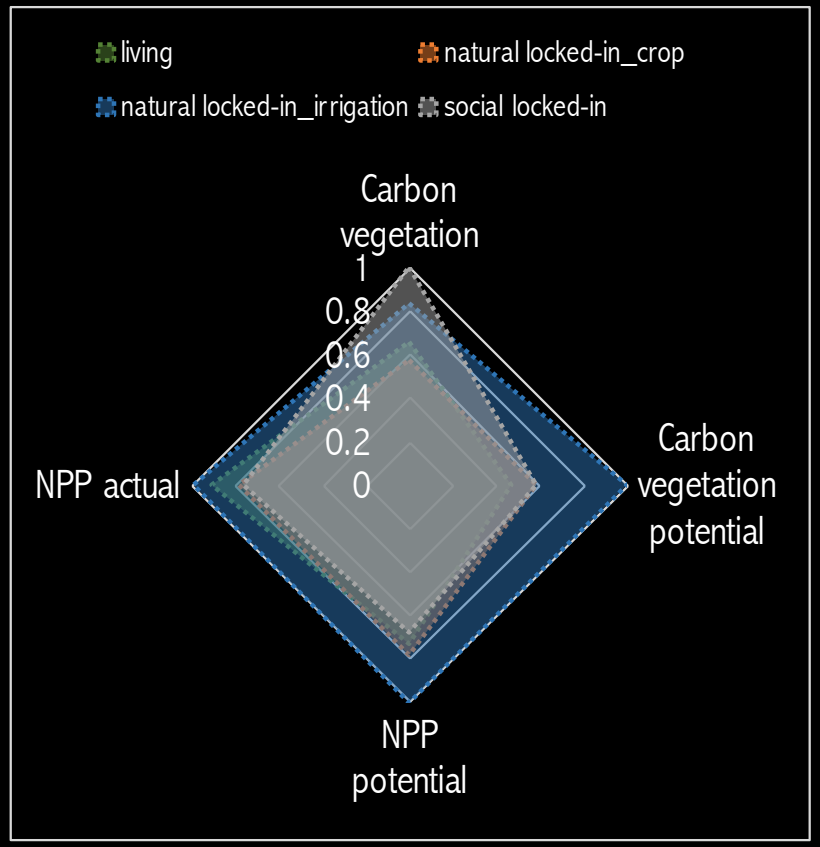
Soil



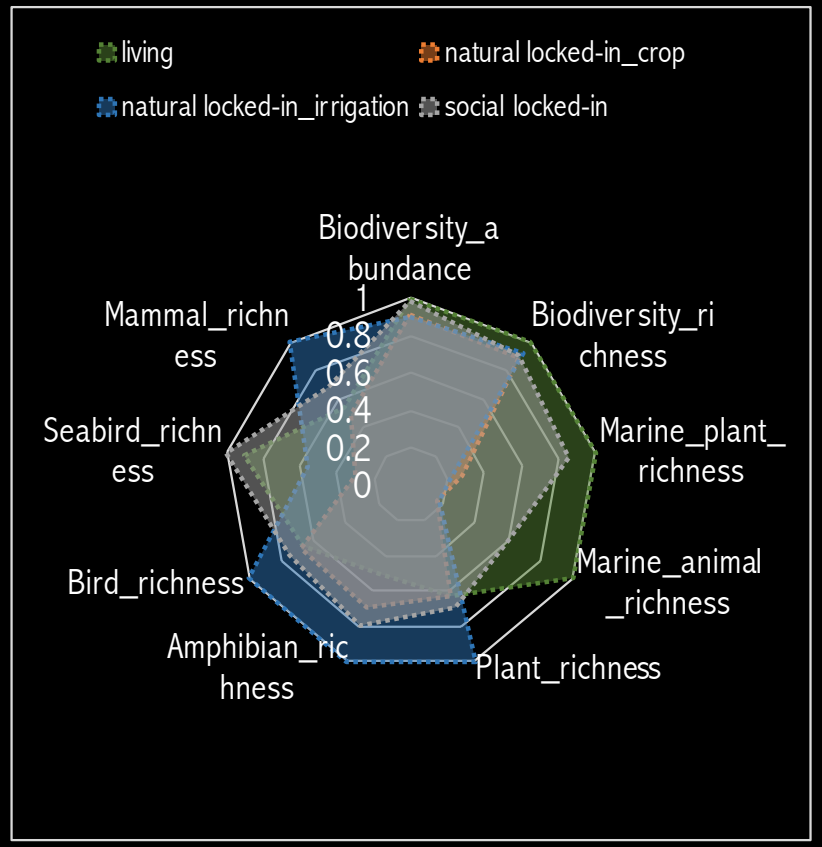
Results – Delta supply of NCPs

- Living and social lock-in deltas supply the most biodiversity, but also most invasive species
- Social lock-in supply the most pollination

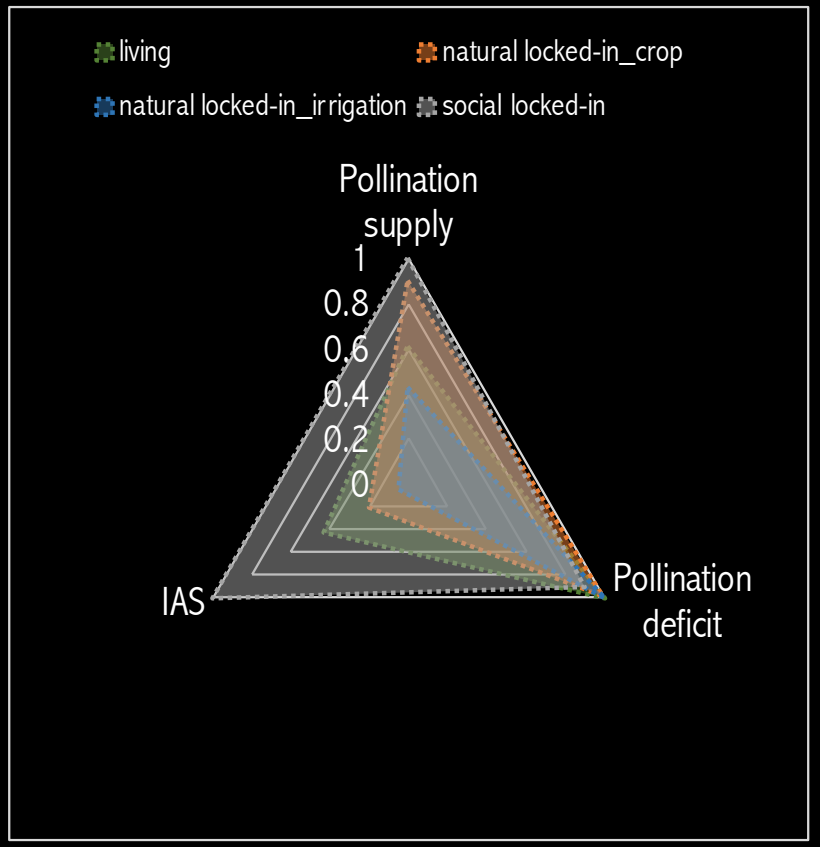
Carbon vegetation



Biodiversity



Pollination + Invasive species



Deltas at Risk

(i) Half of the analyzed deltas are lock-in, i.e. lost resilience

(ii) Most at risk of:

- (i) relative sea level rise (RSLR)
- (ii) hazards
- (iii) anthropogenic conditioning
- (iv) investment deficit
- (v) loss of nature's contributions to people
  - (i) Food
  - (ii) Water
  - (iii) Soil
  - (iv) Carbon vegetation
  - (v) Biodiversity
  - (vi) Pollination and invasives

where do lock-in deltas differ? ACI, water, soil, biodiversity

This means their populations are more at risk of hazards, and decreased water supply


Thank you for your attention
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