Global Drought Atlas

Annual Advisory Committee Meeting of the
Integrated Drought Management Programme (IDMP)

25-26 June 2024

The Global Drought Atlas

GOAL

- Compile a **global overview** on drought issues
- Facilitate knowledge **sharing**
- Inform upcoming **policy processes** (e.g. UNCCD COP16)

TARGET

- National and international **policy-makers**
- **Practitioners** and **scientific community**
- **General public** (incl. vulnerable communities)

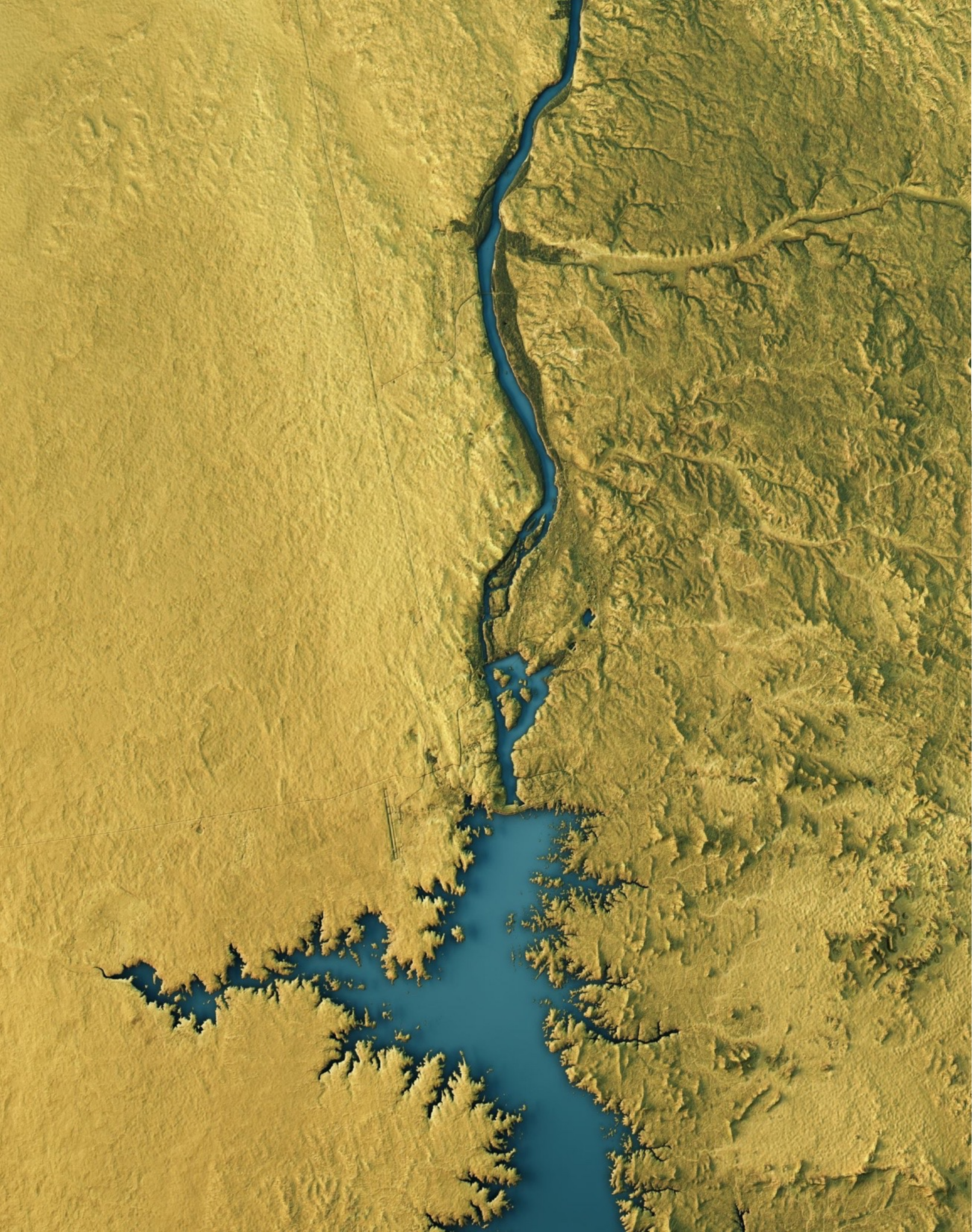
The Global Drought Atlas

Main messages

Drought is a complex hazard that affects multiple sectors and systems

Impacts are diverse, cross-sectoral, interconnected and their geography is changing

Solutions need to address multiple risks & impacts



Atlas features

- Maps and infographics
- Conceptual models
- Explanatory texts and narrative (synthetic)
- Boxes: deep-dives on selected topics
- Length: 100-120 pages
- Format: Digital and printed

Structure

Foreword (UNCCD)

Preface & scope

Part 1: Introduction

Part 2: Impacted systems

Part 3: Examples from the World

Part 4: Managing and adapting to drought risk

Part 1: Introduction

- Motivations

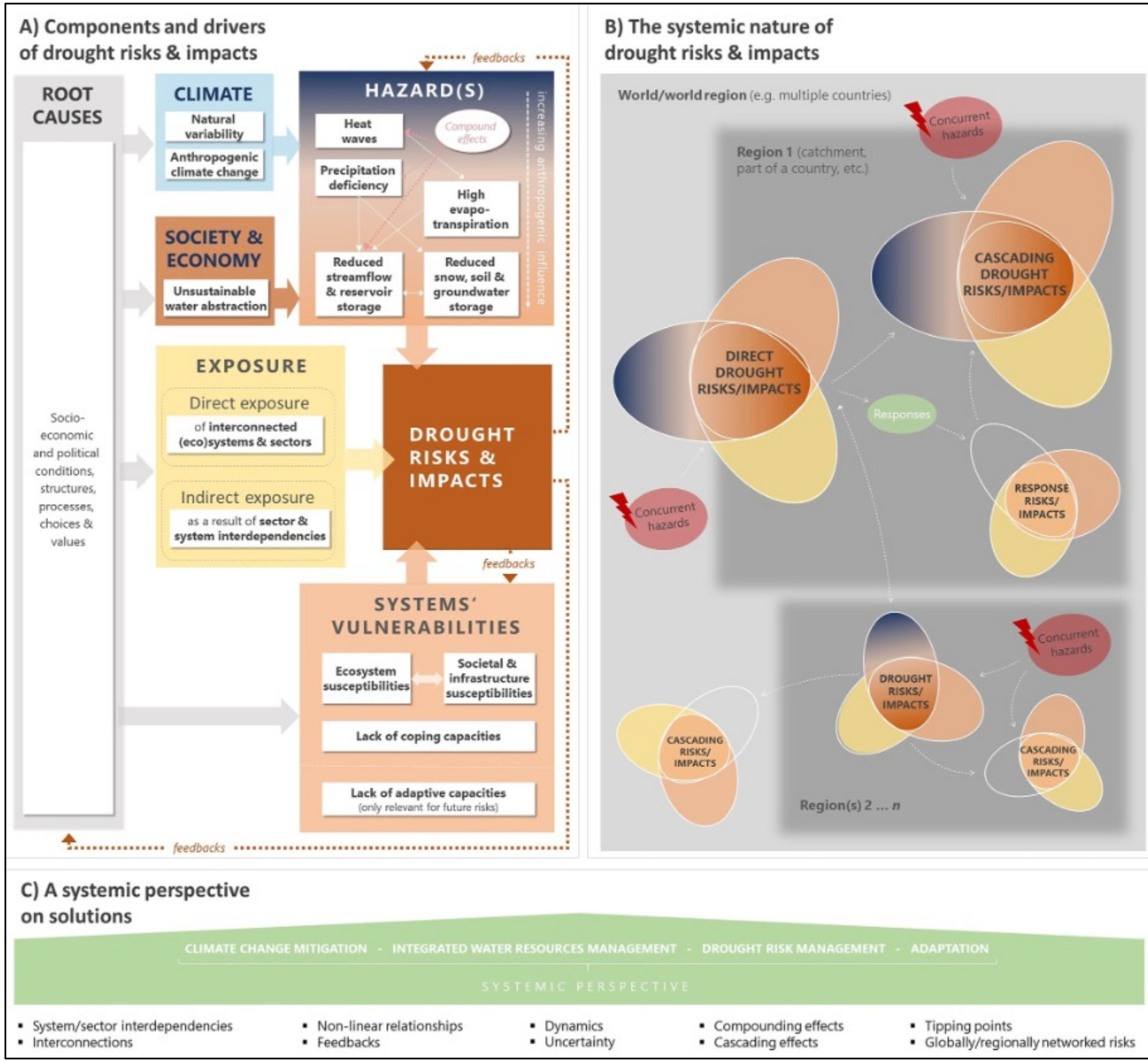
- Definitions and state-of-the art knowledge of drought issues

- Conceptual framework: the need for a multi-sectoral & systemic approach

[~10 pages]

Conceptual framework

- Expansion of the IPCC framework: R = H x E x V
- Impact-oriented approach (land perspective)
- Hazard: climate + anthropogenic components
- Direct and indirect impacts (system interdependencies)
- Systemic drought risk management and adaptation strive to avoid trade-offs and maladaptation and to identify leverage points for positive cascading effects for communities and sectors



Hagenlocher et al. 2023

Part 2: Impacted systems at global level

AGRICULTURE	PUBLIC WATER SUPPLY	HYDROPOWER	INLAND NAVIGATION	ECOSYSTEMS
~ 20 pp.	~ 10 pp.	~ 10 pp.	~ 5-7 pp.	~ 15 pp.

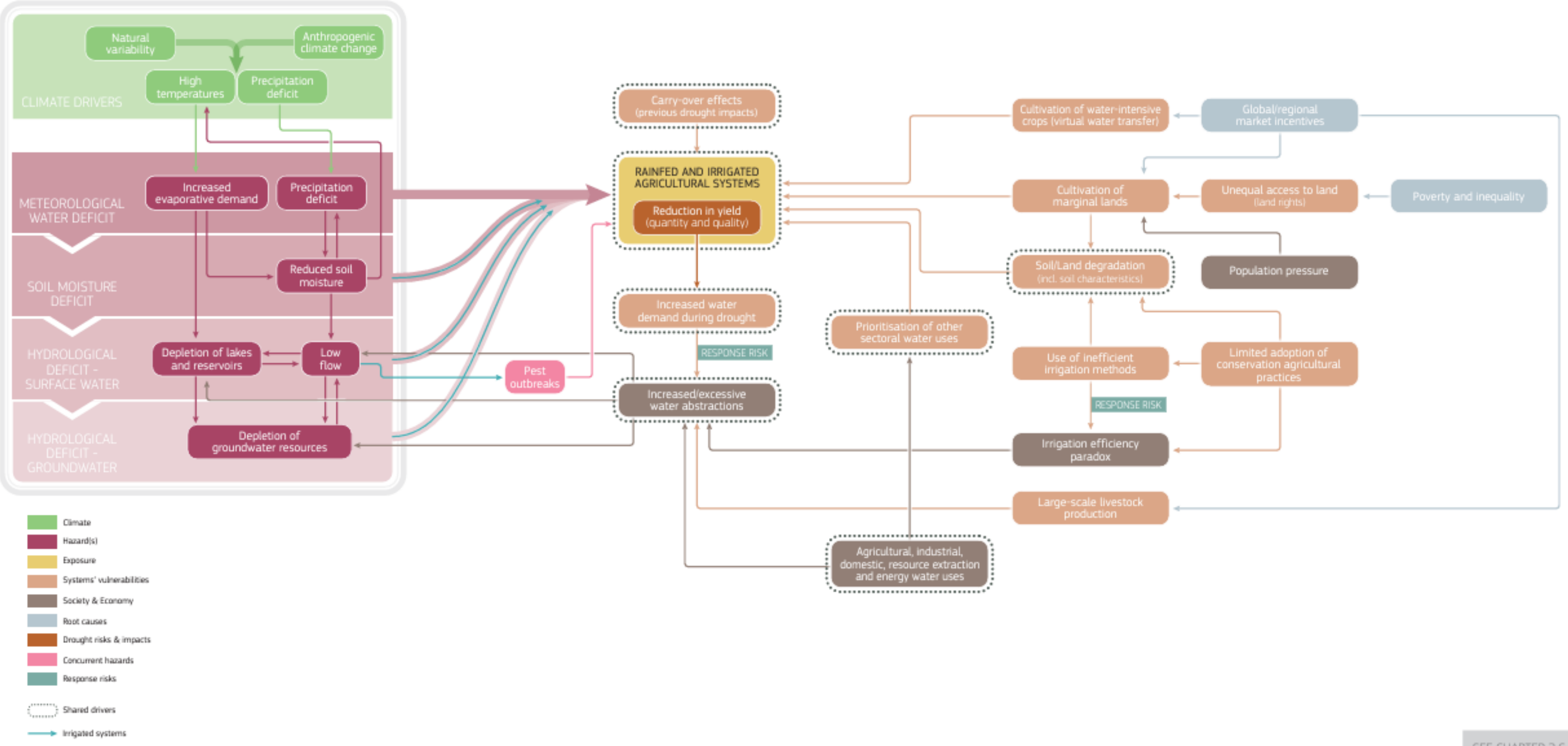
[~70 pages]

2.1 Agriculture

[~20 pages]

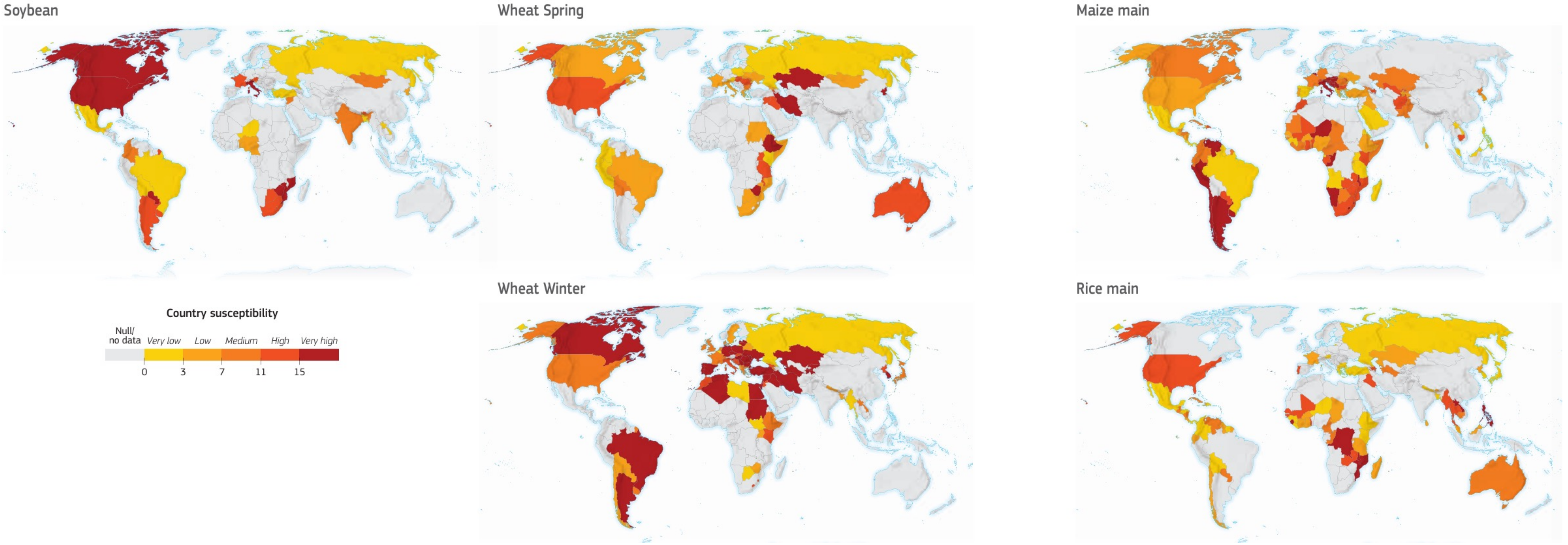
- **Short intro** on the relevance of this sector to droughts
- **Conceptual model** of drought risks for agriculture & livestock
- **Current & future hazard**: SMA-3
- **Topics**
    1. Livestock: cattle, poultry, pigs
    2. Major crops: wheat, maize, rice, soy
    3. Flash droughts & heat events
    4. Virtual water transfers
    5. Drought impacts on crop yields
    6. Livelihoods
    7. Irrigation efficiency paradox

Conceptual model for agriculture

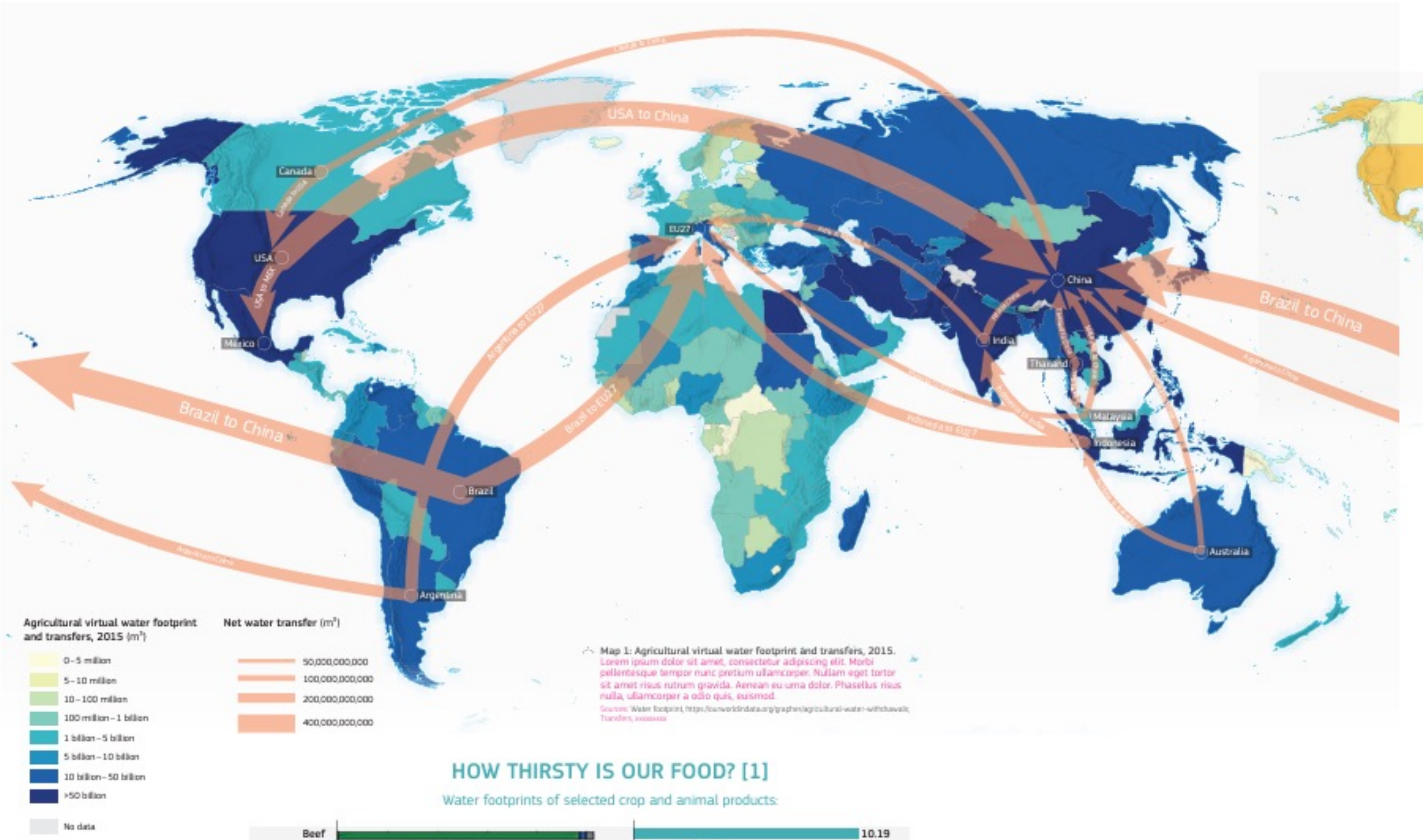


SEE CHAPTER 2.6 FOR CASCADING IMPACTS

Drought impacts on crop yelds

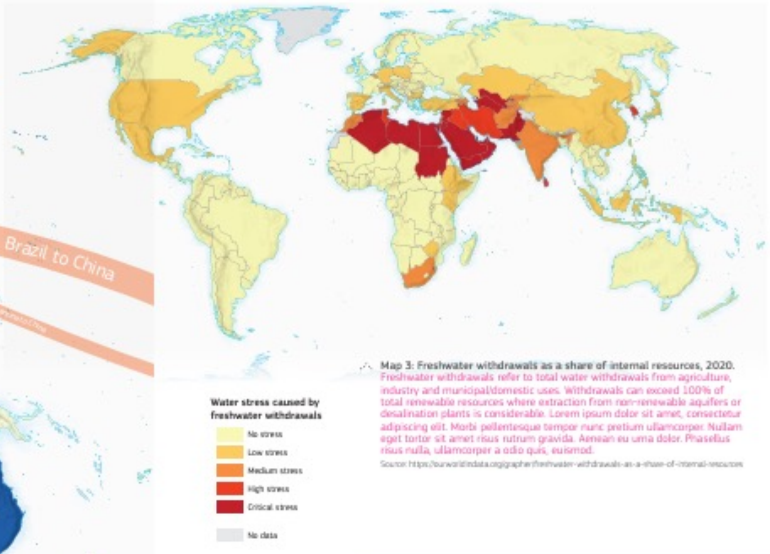


Virtual water from agriculture



Map 1: Agricultural virtual water footprint and transfers, 2015. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Morbi pellentesque tempor nunc pretium ullamcorper. Nullam eget tortor sit amet risus rutrum gravida. Aenean eu urna dolor. Phasellus risus nulla, ullamcorper a odio quis, euismod.

Sources: Water footprint, https://ourworldindata.org/grapher/agricultural-water-withdrawals; Transfers, xxxxxxxx



Map 3: Freshwater withdrawals as a share of internal resources, 2020. Freshwater withdrawals refer to total water withdrawals from agriculture, industry and municipal/domestic uses. Withdrawals can exceed 100% of total renewable resources where extraction from non-renewable aquifers or desalination plants is considerable. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Morbi pellentesque tempor nunc pretium ullamcorper. Nullam eget tortor sit amet risus rutrum gravida. Aenean eu urna dolor. Phasellus risus nulla, ullamcorper a odio quis, euismod.

Source: https://ourworldindata.org/grapher/freshwater-withdrawals-as-a-share-of-internal-resources

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HOW THIRSTY IS OUR FOOD? [1]

Water footprints of selected crop and animal products

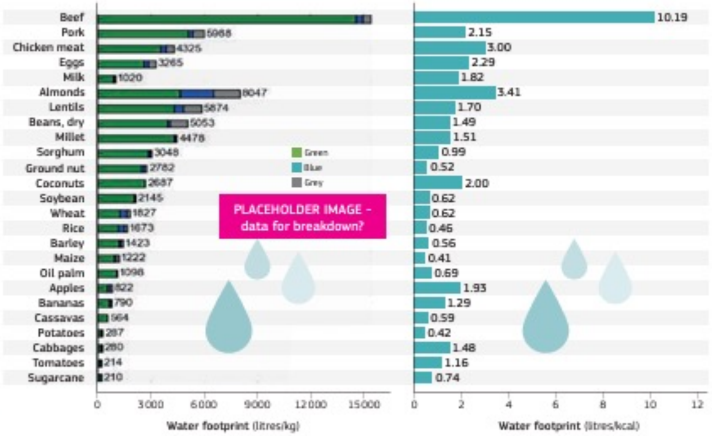
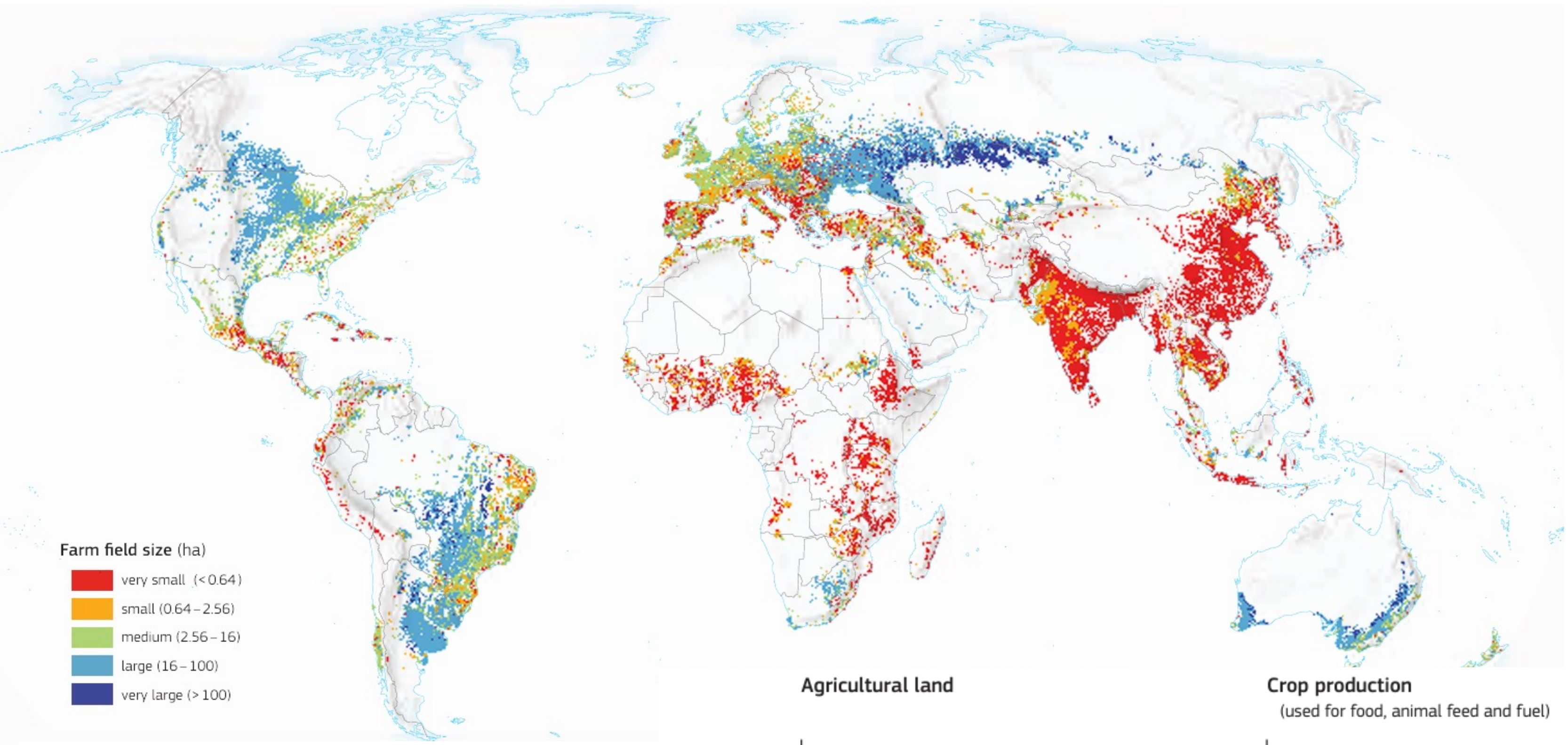


Fig. 1: Water footprints of selected crop and animal products.
Left, WF in a litre of water per kg of product; Right, WF in a litre of water per kcal of nutritional energy contained in the product.
Source: https://www.mdpi.com/2075-4441/12/10/2696#B57-water-12-02696 Data from Mekonnen and Hoekstra [29] and Mekonnen and Hoekstra [57].

Virtual water

Virtual water is the total amount of water required to produce a commodity (e.g. food). Every gram of food traded, carries virtual water from where it is produced to where it is consumed. Global trade, including food trade, has steadily expanded in a gradually more interconnected world. Agriculture is the largest contributor to virtual water (56%). Every year, trillions of cubic meters of virtual water are transported in global trade. Water scarcity is a serious global problem, impacting about two thirds of the global population for at least one month a year. In addition, climate change is altering rainfall and evaporative potential patterns across the world leading to further changes in water availability in many regions. Virtual water can both alleviate water shortages in water stressed territories but at the same time in can exacerbate water shortage through virtual water exports. For example, the global appetite of certain foods with high water demand can lead to unsustainable water use in a region and worsen water stress. It is of great concern that many countries in a medium to extremely high water stress status, also use an important fraction of their available water for agriculture.

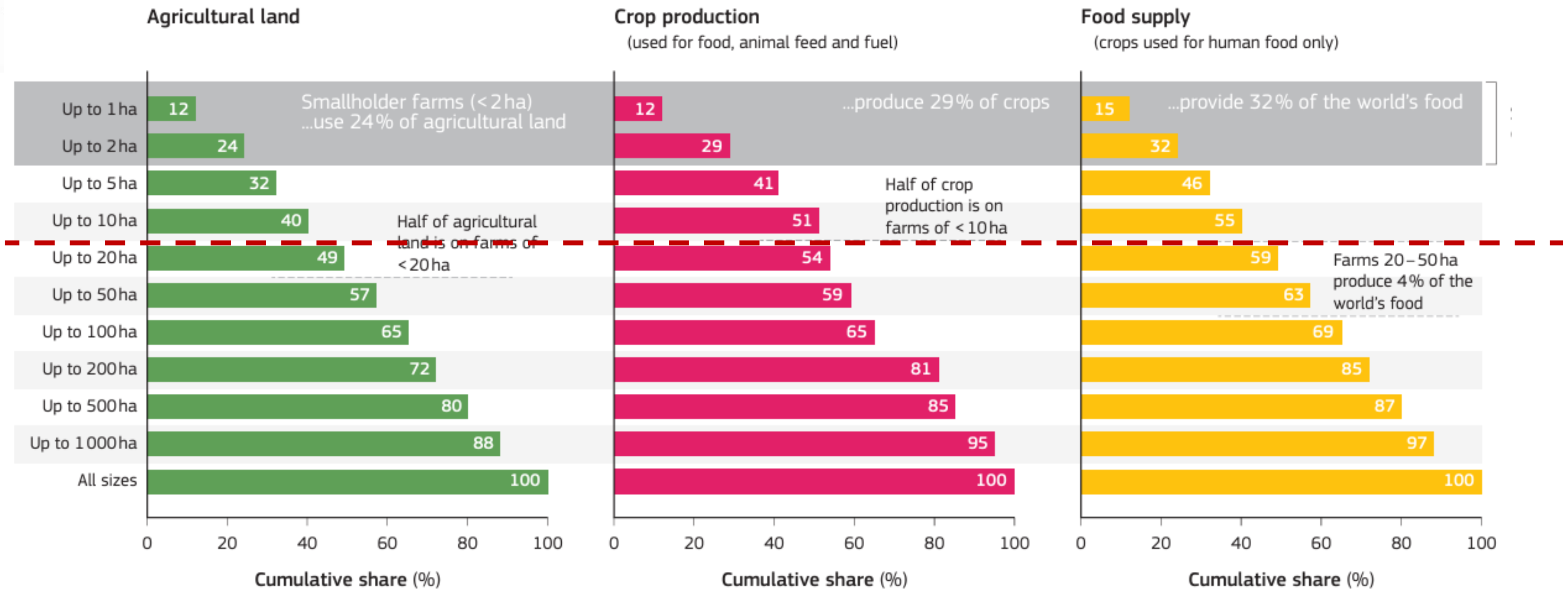
Agricultural dependency and livelihoods



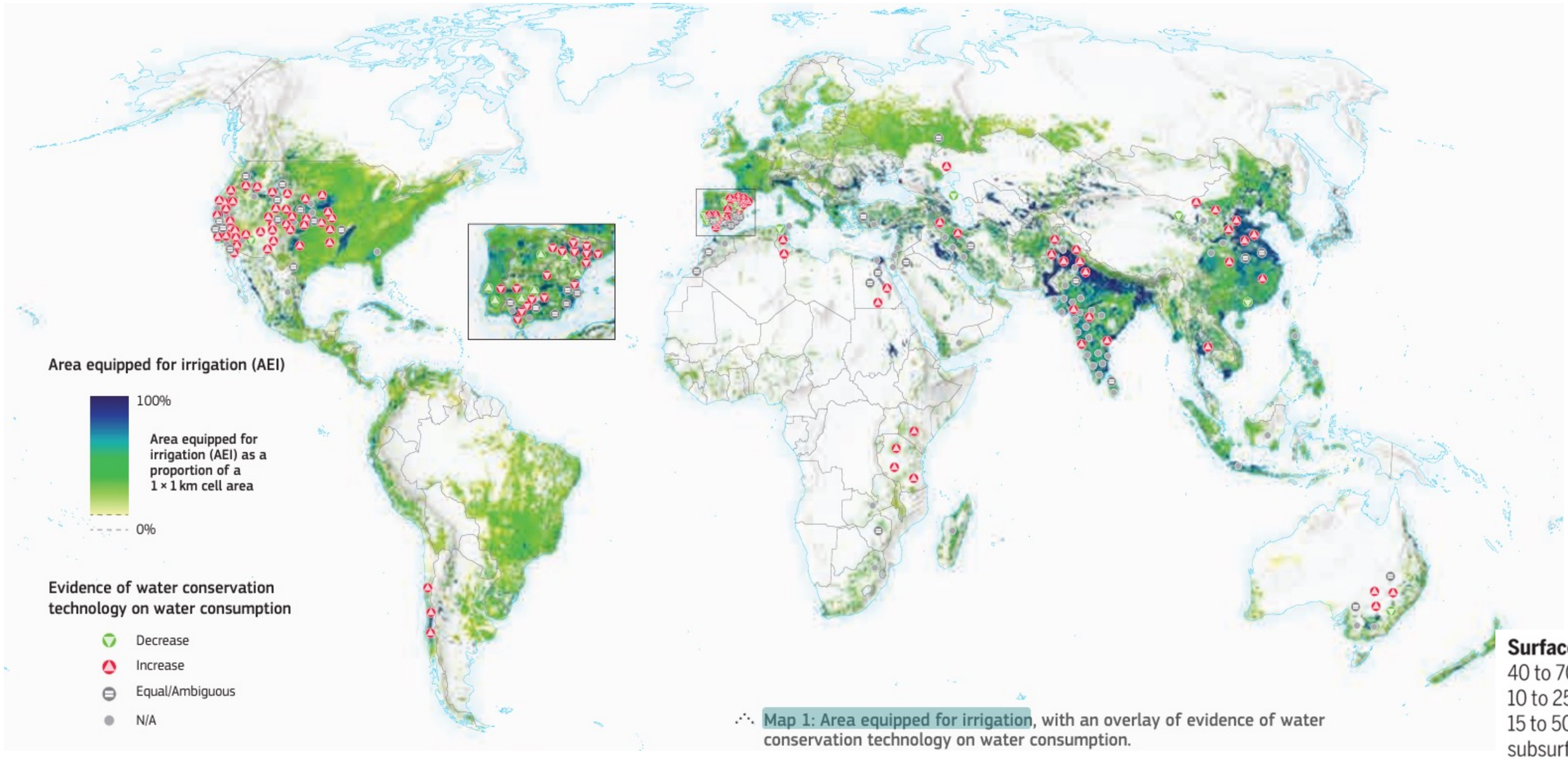
Farms of < 10ha use 40% of agricultural lands and produce 55% of the world's food

Small farmers:

- combat undernutrition
- provide crop diversity
- lower post-harvest losses



The irrigation efficiency paradox

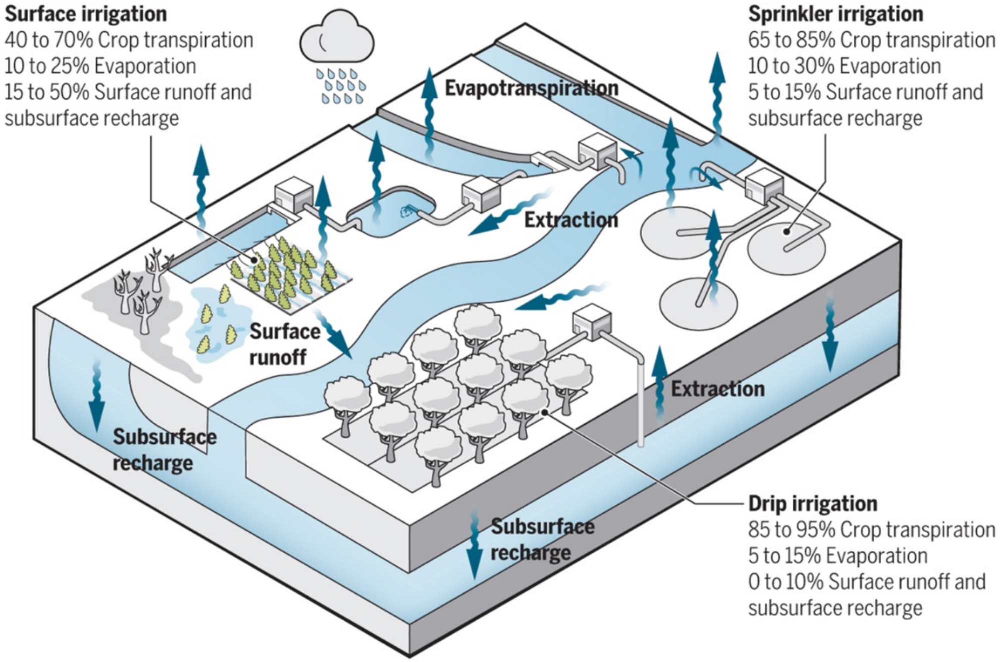


Map 1: Area equipped for irrigation, with an overlay of evidence of water conservation technology on water consumption.

Increase in water efficiency

↓

Increase in water consumption, if not accompanied by policies



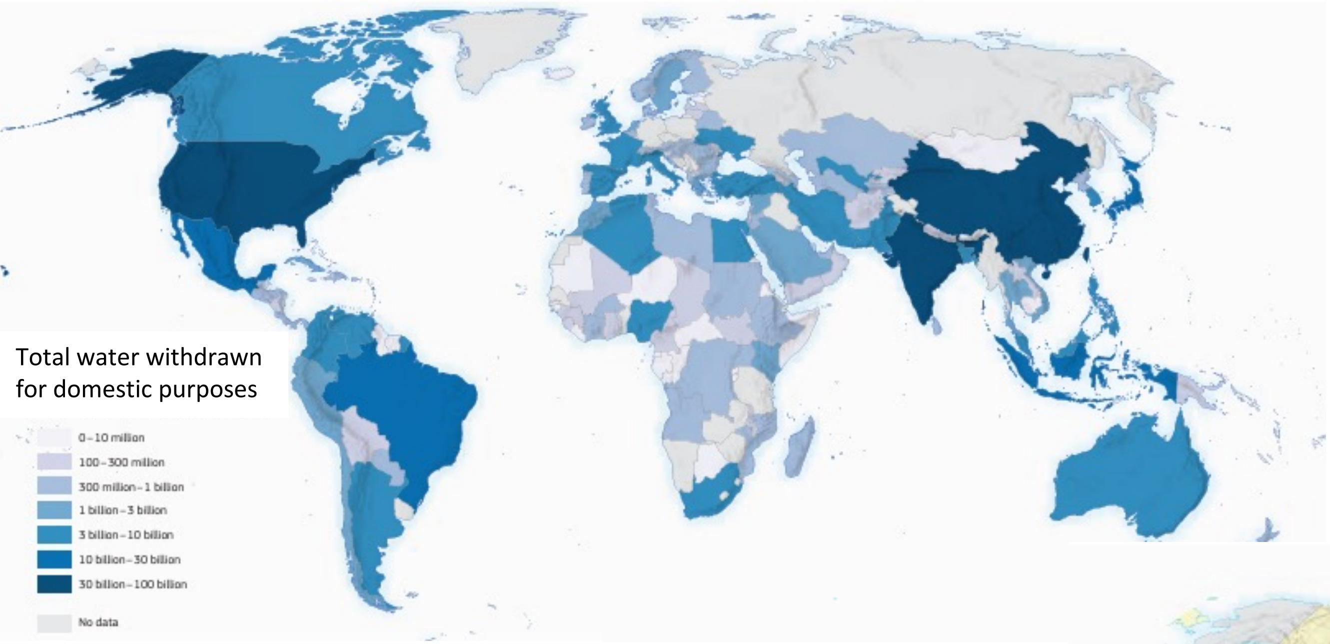
Grafton, R. Q. at al. (2018). The paradox of irrigation efficiency. Science, 361(6404), 748-750.

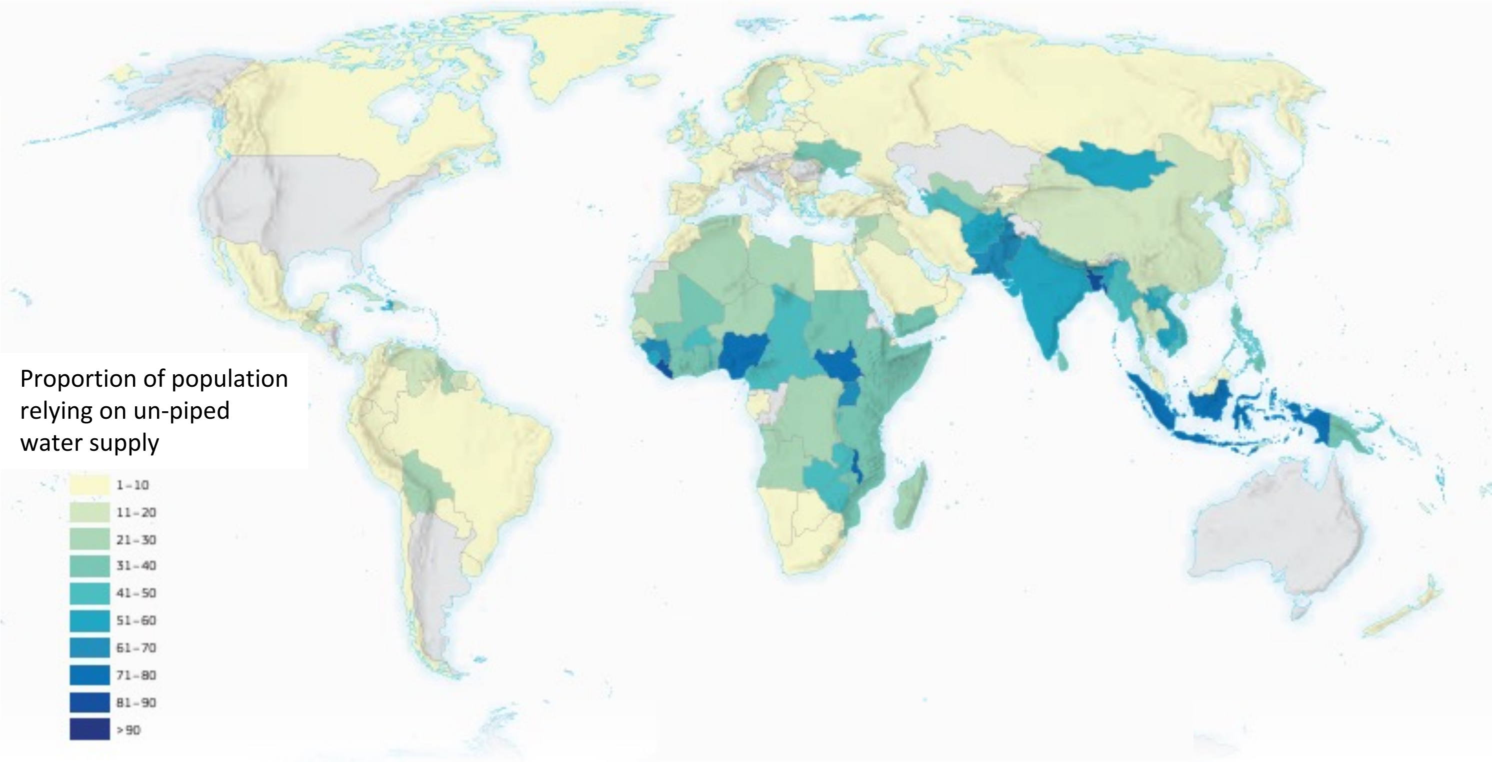
2.2 Public water supply

[~10 pages]

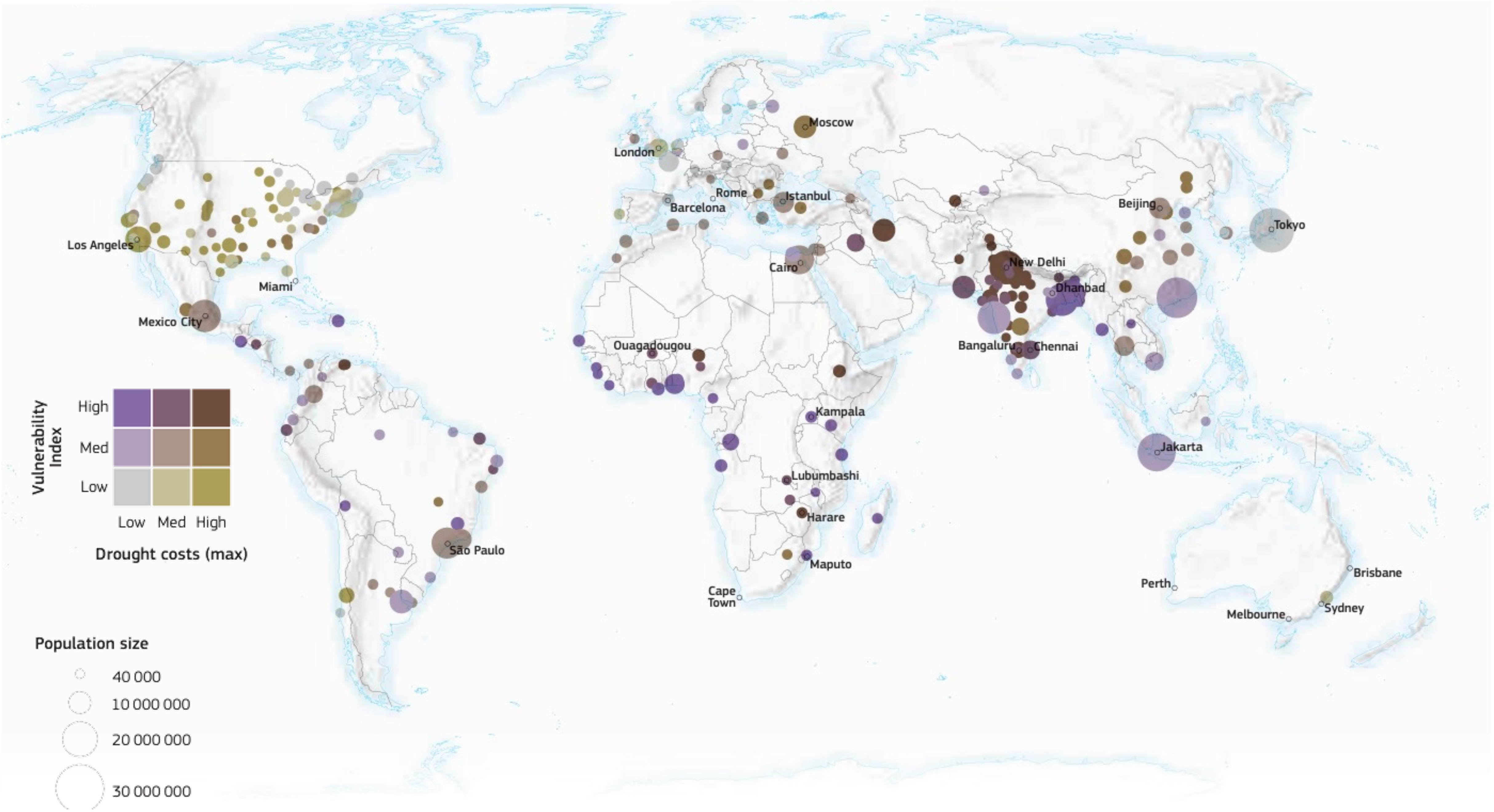
- **Short intro** on the relevance of this sector to droughts
- **Conceptual model** of drought risks for public water supply
- **Current & future hazard**: SPEI-12
- **Topics**
    1. Renewable water & diversity of water resources
    2. Urban drought risk
    3. Water supply for sanitation & hygiene

Domestic water use



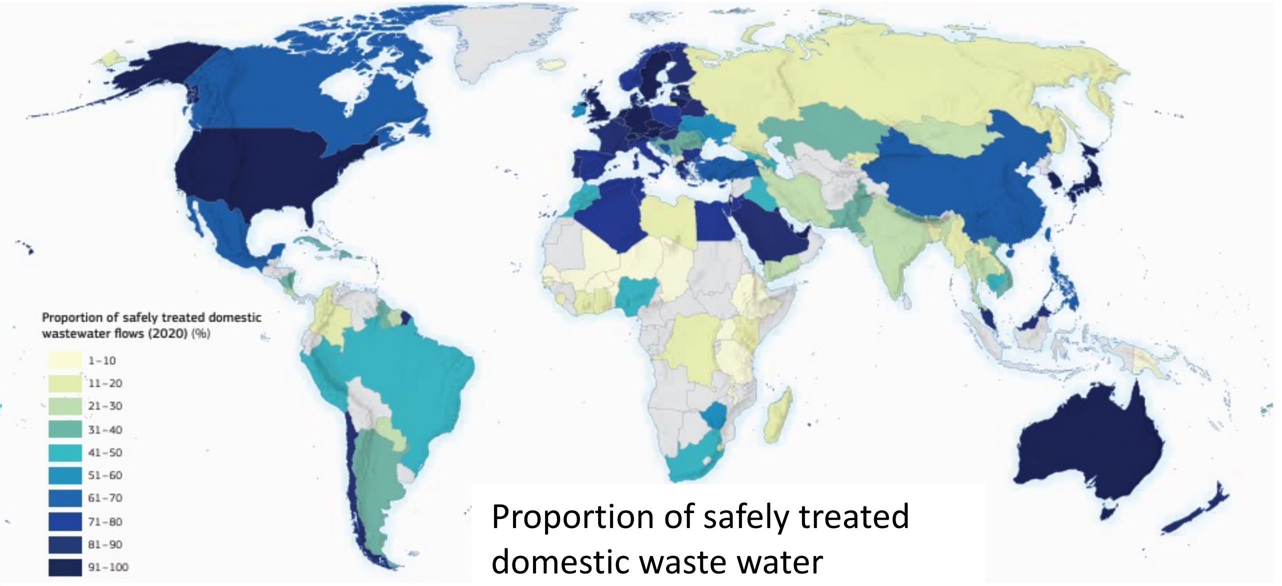


Urban drought risk



Water sanitation and hygiene

Share of population safely using managed drinking water

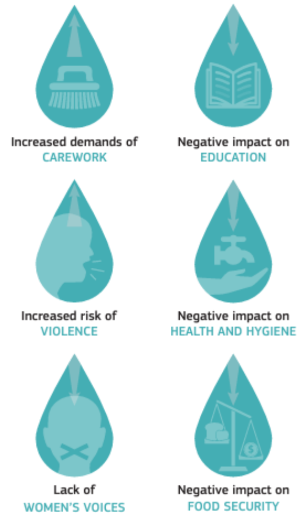


Proportion of safely treated domestic waste water

Share of population safely using managed sanitation facilities

THE WATER CRISIS AFFECTS WOMEN MORE THAN MEN

Lack of access to water places a heavy burden on women and girls:



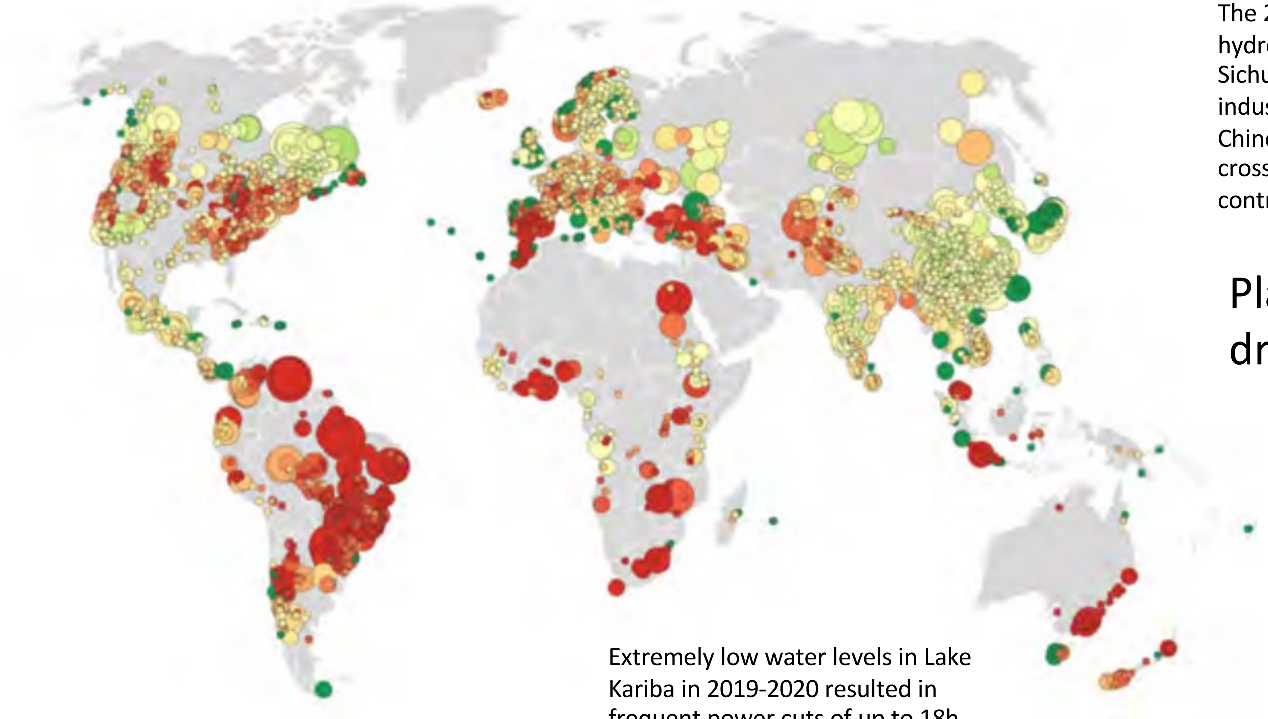
2.3 Hydropower

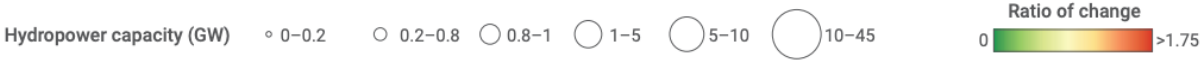
[~10 pages]

- **Short intro** on the relevance of this sector to droughts
- **Conceptual model** of drought risks for HP
- **Current & future hazard**: SQI-6
- **Topics**
    1. Drought impacts on hydropower
    2. Economic impacts
    3. Environmental impacts
    4. Compound events (e.g. hydropower & conflicts)

The impacts of droughts on hydropower

Current hydropower generation exposed to change in drought duration

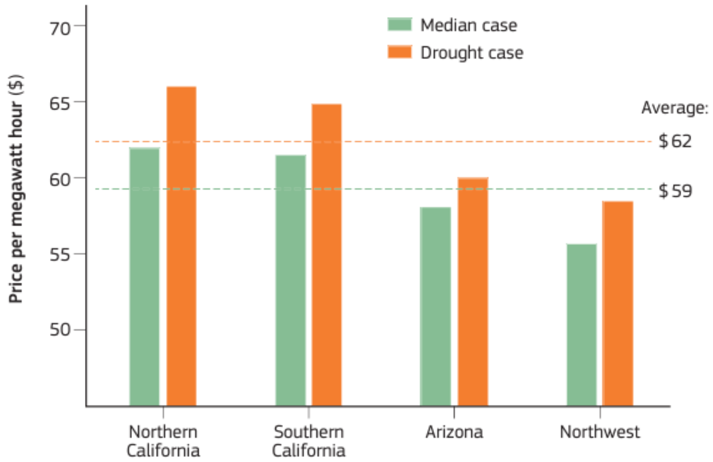




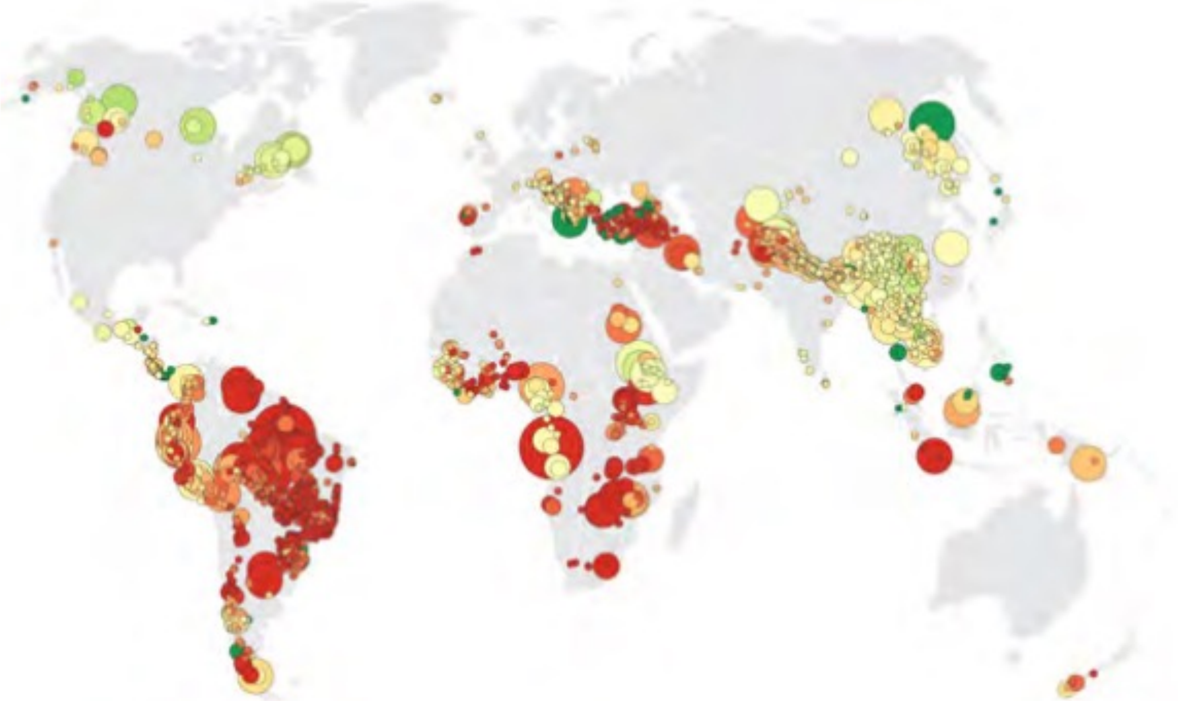
In 2023, the drought in the Amazon region led to the two-week shutdown of Brazil's 4th largest hydropower operator, located on the Rio Madeira

Extremely low water levels in Lake Kariba in 2019-2020 resulted in frequent power cuts of up to 18h per day for at least 3 months in Zimbabwe

The 2022 drought in China's biggest hydropower producing province, Sichuan, led to disruptions to local industries, while exports to other Chinese regions had to continue to fulfil cross-provincial power transmission contracts



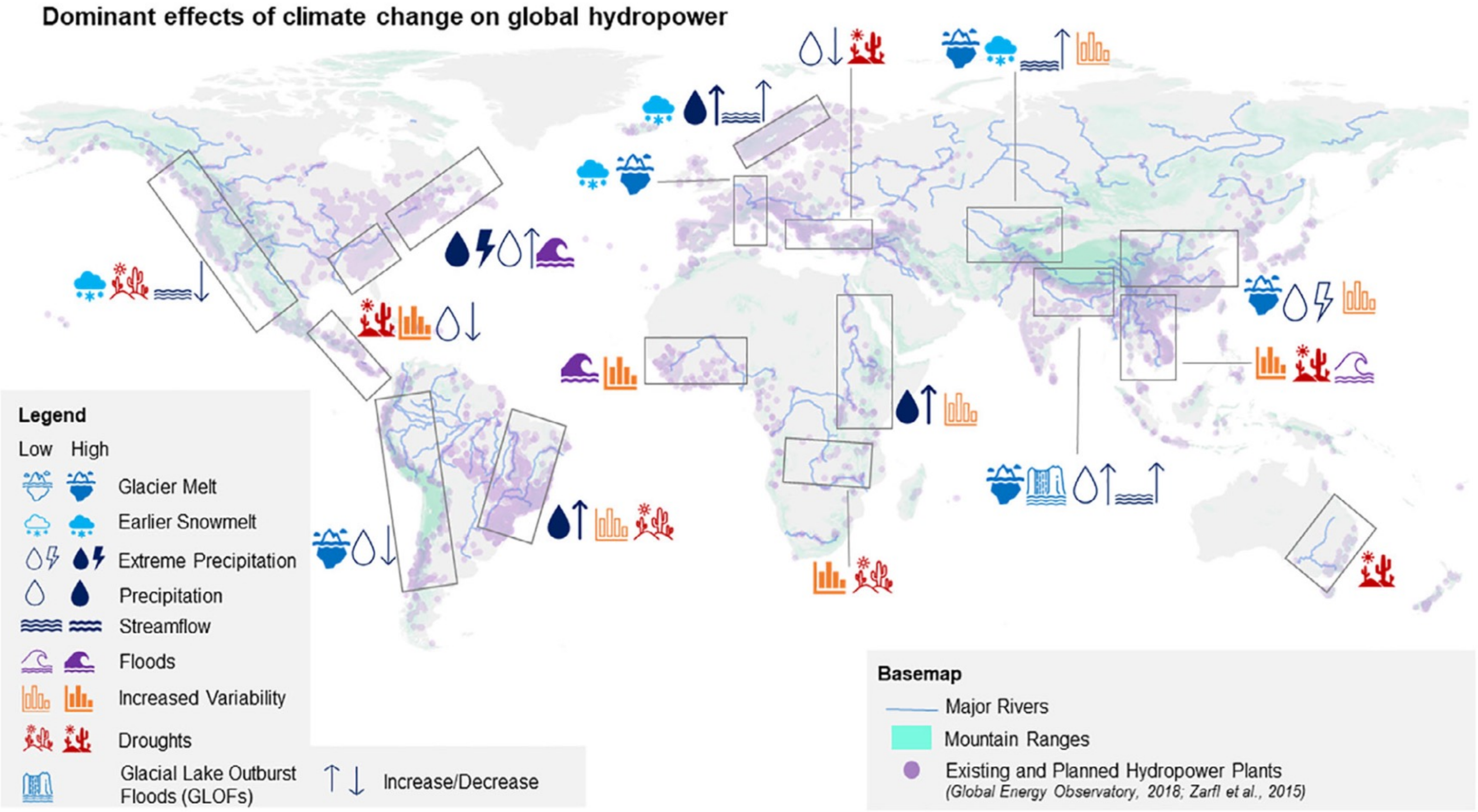
Planned future hydropower generation exposed to change in drought duration



Source: WB report: "What the future has in store. A New Paradigm for Water Storage"

Compound events

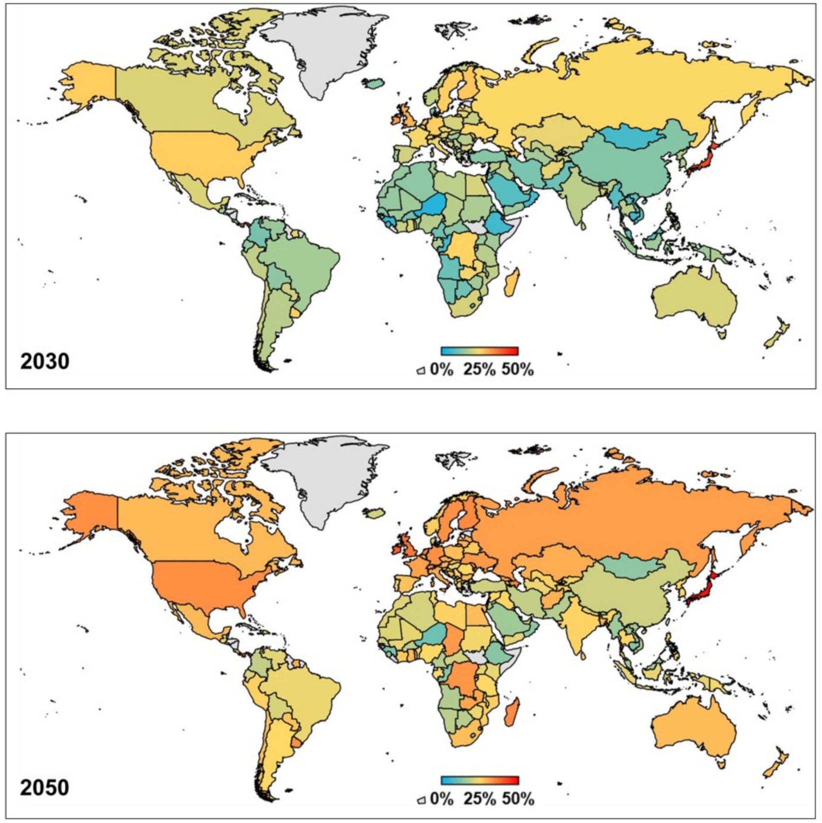
Negative impacts of droughts on hydropower can be exacerbated by compounding weather and climate events



Floods

Soil erosion

Sediment accumulation in reservoirs

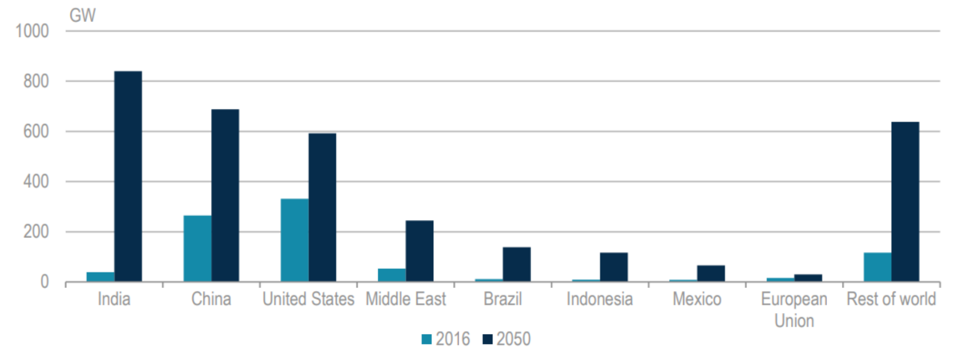


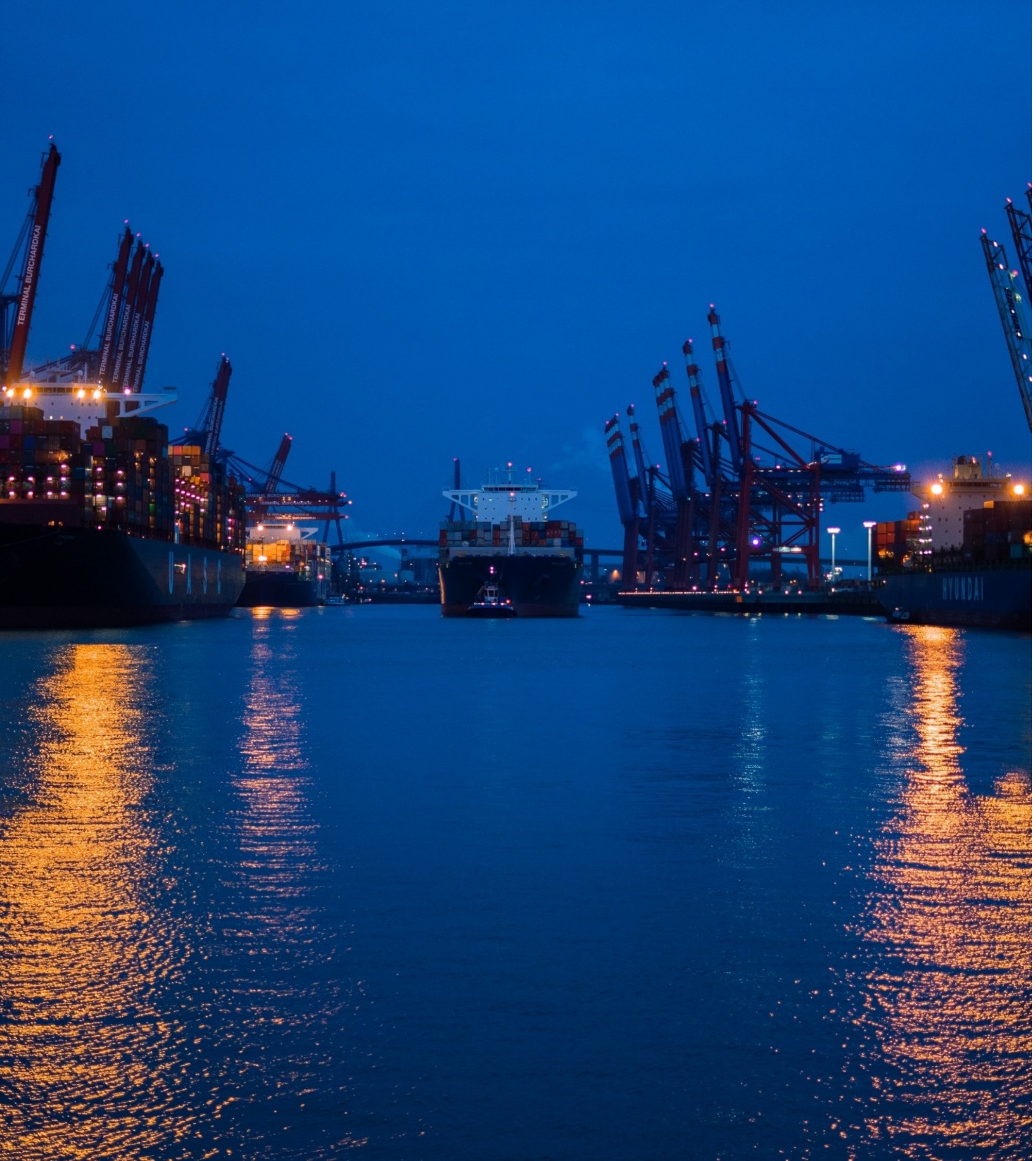
In addition to favouring low water storage, floods can increase erosion upstream and thus cause more sediments to flow into downstream reservoirs (Ward et al. 2020). This exacerbates the already existing problem of reservoir storage capacity loss due to sediment filling (Perera et al. 2023).

Heatwaves

Increase cooling needs, when water is unavailable

Figure 3.11 • Power generation capacity required for cooling by country/region in the Baseline Scenario





2.4 Inland navigation

[~5-7 pages]

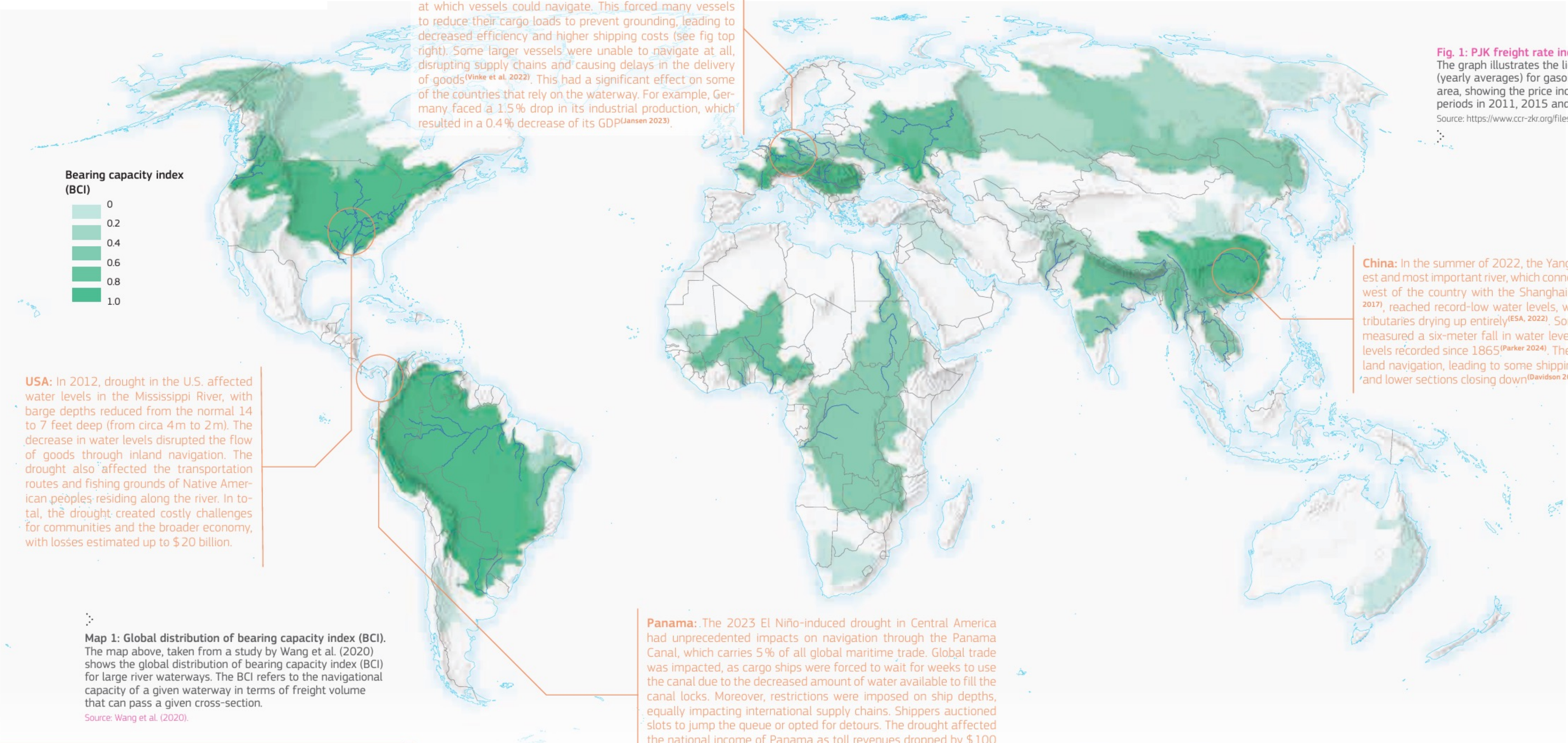
- **Short intro** on the relevance of this sector to droughts
- **Conceptual model** of drought risks for inland navigation
- **Current & future hazard**: Low Flow Index
- **Topics**
    1. Drought impacts on large shipping corridors
    2. Social & economic impacts

Disrupted supply chains

Rhine: The 2018 drought in Europe impaired navigation on the Rhine **(see Fig. 1, top right)**, Europe's busiest waterway corridor, on which raw materials and finished goods from multiple industries along its riverbanks are transported. Water levels dropped to historic lows, severely limiting the depth at which vessels could navigate. This forced many vessels to reduce their cargo loads to prevent grounding, leading to decreased efficiency and higher shipping costs (see fig top right). Some larger vessels were unable to navigate at all, disrupting supply chains and causing delays in the delivery of goods[Vinke et al. 2022]. This had a significant effect on some of the countries that rely on the waterway. For example, Germany faced a 1.5 % drop in its industrial production, which resulted in a 0.4 % decrease of its GDP[Jansen 2023].

Fig. 1: PJK freight rate index for the Rhine Region. The graph illustrates the liquid cargo freight rate ind (yearly averages) for gasoil transport in the ARA-Rhi area, showing the price increase during the low flow periods in 2011, 2015 and 2018.

Source: https://www.ccr-zkr.org/files/documents/om/om22_II_en.pdf



China: In the summer of 2022, the Yangtze River, China's longest and most important river, which connects the mid and southwest of the country with the Shanghai seaport[Konings & Wiegmans 2017], reached record-low water levels, with some sections and tributaries drying up entirely[ESA, 2022]. Some monitoring stations measured a six-meter fall in water levels, reaching the lowest levels recorded since 1865[Parker 2024]. The low flows affected inland navigation, leading to some shipping routes in the middle and lower sections closing down[Davidson 2022].

USA: In 2012, drought in the U.S. affected water levels in the Mississippi River, with barge depths reduced from the normal 14 to 7 feet deep (from circa 4 m to 2 m). The decrease in water levels disrupted the flow of goods through inland navigation. The drought also affected the transportation routes and fishing grounds of Native American peoples residing along the river. In total, the drought created costly challenges for communities and the broader economy, with losses estimated up to $ 20 billion.

Map 1: Global distribution of bearing capacity index (BCI). The map above, taken from a study by Wang et al. (2020) shows the global distribution of bearing capacity index (BCI) for large river waterways. The BCI refers to the navigational capacity of a given waterway in terms of freight volume that can pass a given cross-section.

Source: Wang et al. (2020).

Panama: The 2023 El Niño-induced drought in Central America had unprecedented impacts on navigation through the Panama Canal, which carries 5 % of all global maritime trade. Global trade was impacted, as cargo ships were forced to wait for weeks to use the canal due to the decreased amount of water available to fill the canal locks. Moreover, restrictions were imposed on ship depths, equally impacting international supply chains. Shippers auctioned slots to jump the queue or opted for detours. The drought affected the national income of Panama as toll revenues dropped by $ 100 million per month[Moreno, 2024], threatening employment in canal-related industries[World Weather Attribution 2024].

Impaired inland navigation can have cascading effects through supply chains and trade.

2.5 Ecosystems

[~15 pages]

- **Short intro** on the relevance of this sector to droughts
  1. affected processes, possible feedbacks
  2. tipping points and long-term trends
  3. how drought manifests in different biomes
- **Conceptual model** of drought risks for ecosystems
- **Current & future hazard**: SPEI-6
- **Topics**
  1. Biodiversity
  2. Carbon cycling
  3. Ecosystem transformation
  4. Compound hazards

Biodiversity

Drought can negatively impact biodiversity, but biodiversity can mitigate drought impacts to an ecosystem.

Drought can negatively impact biodiversity, but biodiversity can mitigate drought impacts to an ecosystem.

Drought can impact terrestrial ecosystems both above and belowground as well as aquatic and coastal ecosystems. Impacts can be both **direct** (for example, reductions in water flows can trigger fish die-offs, (see Fig. xx, opposite-bottom)) or **indirect** (for example, a change in the nutrient composition of leaf litter from drought-stricken vegetation can change the predominance of bacterial versus fungal decomposers, right). Often the impacts on one species cascade through the system; wide-spread tree die-offs in forests result in loss of habitat for other species and in some areas increase the risk of catastrophic wildfire, which can further harm biodiversity (see Fig. xx, below-left).

However, the presence of strong biodiversity levels can also mitigate the impacts of drought. For example, in biodiverse forests, the presence of drought-resilient trees can mitigate overall tree loss, even if the impacts are greater for drought-vulnerable species (see Fig. xx, below-right). This argues for drought mitigation measures in order to protect biodiversity as well as biodiversity protection and enhancement in order to mitigate drought.

Fig. 1: Drought impacts to tropical forest ecosystems.
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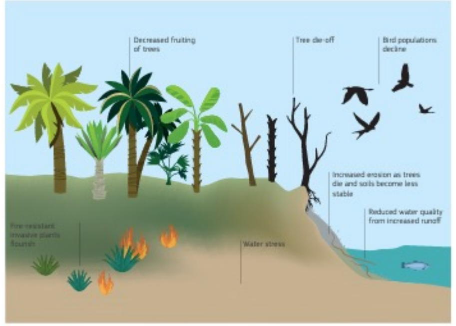
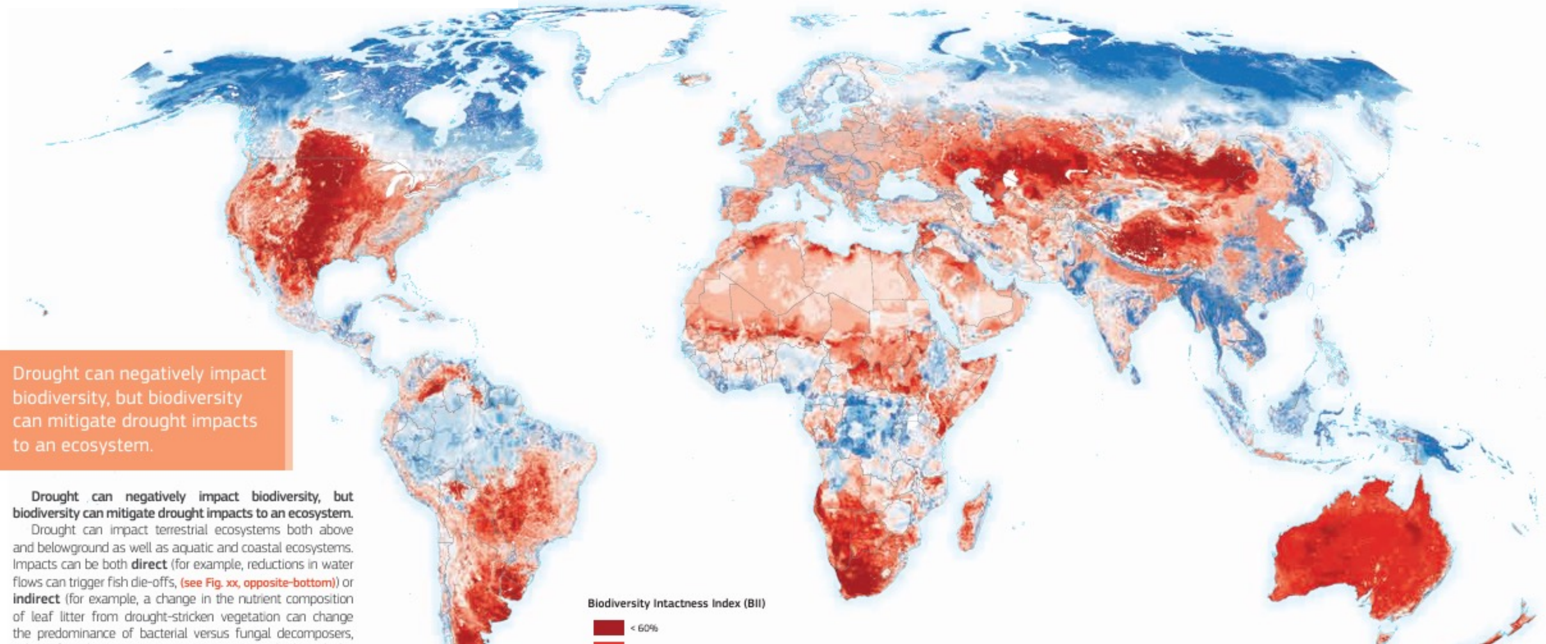
Source: Redrawn by LJ for the Global Drought Atlas, based on https://www.usgs.gov/programs/climate-adaptation-science-centers/drought-impacts-tropical-forest-ecosystems-us-caribbean





Biodiversity Intactness Index (BII)

- < 60%
- 60% – 70%
- 70% – 75%
- 75% – 80%
- 80% – 85%
- 85% – 90%
- 90% – 95%
- 95% – 97.5%
- 97.5% – 100%
- > 100%

Map 1: Global map of biodiversity intactness index.
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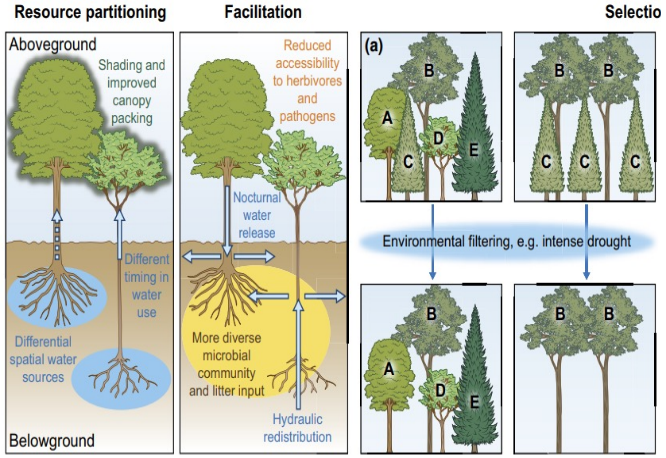
Source: https://www.science.org/doi/10.1126/science.aaf2201; https://data.nhm.ac.uk/dataset/global-map-of-the-biodiversity-intactness-index-from-newbold-et-al-2016-science

Selection



Indigenous stewardship of biodiversity

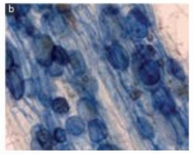
Humans are a critical component of biodiversity, and human actions can both help and harm biodiversity levels. Indigenous peoples are particularly important to protecting biodiversity globally. Though Indigenous groups comprise 6% of the world's population, they steward areas accounting for 80% of the world's biodiversity[1]. Holism and reciprocity are emphasised in many Indigenous value systems, which can offer alternatives to dualistic worldviews that see humans as separate from other parts of the natural world. By emphasising reciprocity, respect, and relationality between humans and other species and ecosystem processes, holistic value systems may be less prone to exploitation and unsustainable use of resources. Among these worldviews, loss or changes in biodiversity directly impact human cultural practices and values. Affirming Indigenous sovereignty, strengthening legal recognition of Indigenous territory, and increasing protections for environmental defenders are critical to protecting biodiversity regionally and globally[2,3,4].

Death of dolphins during Amazon drought

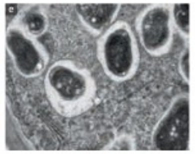
During the Amazonian drought beginning in 2023, the severity of which is largely driven by climate change, more than 150 endangered river dolphins (*Inia geoffrensis* and *Sotalia fluviatilis*) were found dead in tributaries of the Amazon River. While the definitive cause of the deaths is still under investigation, most explanations offered by local experts suggest they are related to drought and heat. Due to high temperatures and low water levels, water temperatures reached up to 9 degrees Celsius warmer than usual. Moreover, the high incidence of solar radiation caused an algae bloom that is potentially toxic to fish, although there is no evidence yet of its toxicity to dolphins. In addition to these threats, low water levels make the dolphins and other freshwater species more accessible and visible to humans, exposing them to activities such as illegal fishing.

Cyptotrama asprata: The Basidiomycota is a group of fungi that comprises the well known, common mushrooms. Their visible part usually has an umbrella-like shape.
Source: SA.

Mimosa foliolosa: Nodules in the roots of a plant, formed by the nitrogen-fixing bacteria *Burkholderia* sp.
Source: FC, FMSM, NI.



Stained roots show the colonisation by arbuscular mycorrhizal fungi (AMF). The AMF develop unique structures within root cells.
Source: SLS, MBR.



Bradyrhizobium japonicum: The soil bacterium (dark circles) colonises the roots of some plants and establishes a symbiosis.
Source: LH/DEMF.

Boletus bicolour: Some of the fungi that are found in woodlands are ectomycorrhizal.
Source: MW.

Margarodes (Hemiptera): Commonly known as ground pearls. The exposed mouthparts are used to feed on and attach to plant roots.
Source: MBE.

Plant-Soil Feedbacks type	Climate change drivers	
	Warming	Drier conditions
Fungi		
Pathogens a	+++	--
Saprotrophic/organic matter decomposers	++	--
AM fungi b	+++	+++
EM fungi c	+	---
Bacteria		
Pathogens	+++	--
Symbiotic N fixers d	0	---
Nonsymbiotic N fixers	0	--
Drought-tolerant microbes	+	+++
Other specific coevolved microbes e	+++	---
Other		
Primary detritivorous invertebrates	++	--
Secondary detritivorous invertebrates	++	--
Root herbivores f	++	--

Fig. 3: Potential impacts of climate change drivers.
Summary of expert assessment of potential impacts of climate change drivers (positive, negative, or neutral) on plant-soil feedbacks based on the general effects of known environmental conditions on soil communities.
Source: https://www.science.org/doi/10.1126/sciadv.aaz1834

Fig. 4: Drought impacts to aquatic ecosystems.
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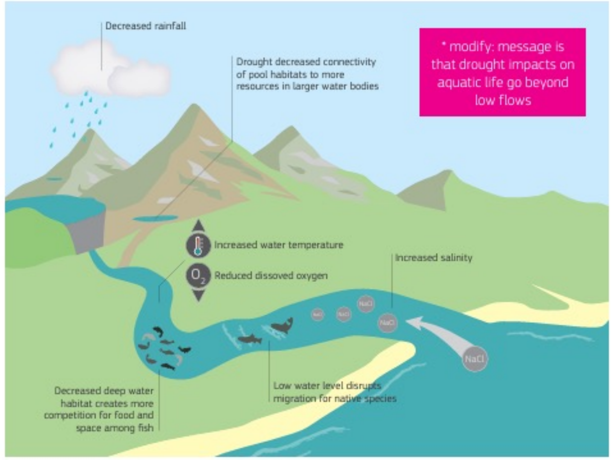
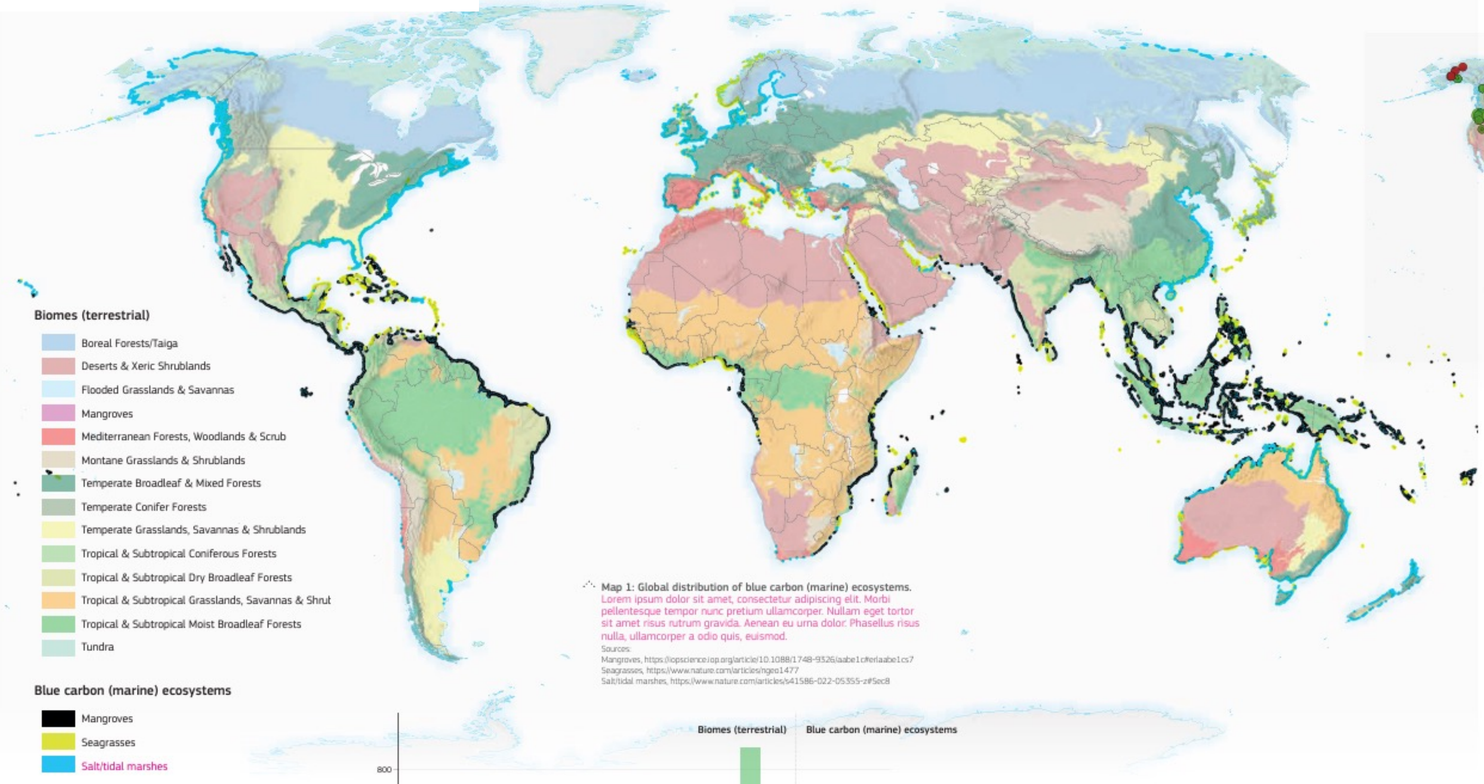
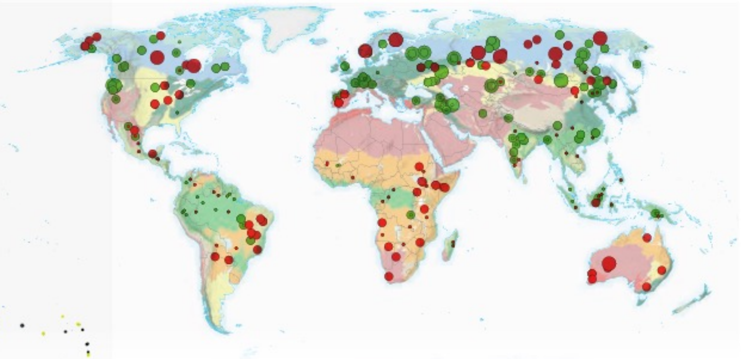
Source: Redrawn by LJ for the Global Drought Atlas, based on https://www.usgs.gov/programs/climate-adaptation-science-centers/drought-impacts-freshwater-ecosystems-us-caribbean



Carbon cycle



Map 1: Global distribution of blue carbon (marine) ecosystems. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Morbi pellentesque tempor nunc pretium ullamcorper. Nullam eget tortor sit amet risus rutrum gravida. Aenean eu urna dolor. Phasellus risus nulla, ullamcorper a odio quis, euismod.
Sources:
Mangroves, https://iopscience.iop.org/article/10.1088/1748-9326/aabe1c#erlaabe1cs7
Seagrasses, https://www.nature.com/articles/ngeo1477
Salt/tidal marshes, https://www.nature.com/articles/s41586-022-05355-z#Sec8



Map 2: Global impact of extreme events on the carbon cycle. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Morbi pellentesque tempor nunc pretium ullamcorper. Nullam eget tortor sit amet risus rutrum gravida. The values reflect positive and negative impacts to GPP (growth or decline) relative to what we would expect outside of the drought.
Source: Base map, https://ecoregions.appspot.com/; data, https://www.nature.com/articles/nature12350

Drought can change the pace and magnitude of the carbon cycle, potentially triggering feedbacks that amplify effects.

Drought can change the pace and magnitude of the carbon cycle, potentially triggering feedbacks that amplify effects.

All ecosystems move carbon, along with other nutrients such as nitrogen and phosphorus, through vegetation, soil, water bodies, and bedrock in a process called carbon cycling. While the periodic release and uptake of carbon is part of healthy ecosystem function, rapid changes in the quantity or timing of the carbon cycle, such as the burning of fossil fuels or widespread deforestation, can trigger tipping points and positive feedback loops that irreversibly alter the global carbon cycle. Longer and more intense droughts, which are linked to climate change, can drive vegetation stress, decreasing carbon uptake through photosynthesis and, in extreme cases, leading to conversion of land cover to systems with less carbon storage potential (right & below).

Both terrestrial and marine systems store carbon, but it is not uniformly distributed (see Fig. 1 right). Old growth forest and grassland ecosystems store more carbon than recently converted landscapes or monoculture plantations (middle right). In addition, certain soil structures are more adept at binding to carbon dioxide. Marine or "blue carbon" ecosystems, meanwhile, can store up to five times more carbon than tropical forests and absorb it at a faster rate.

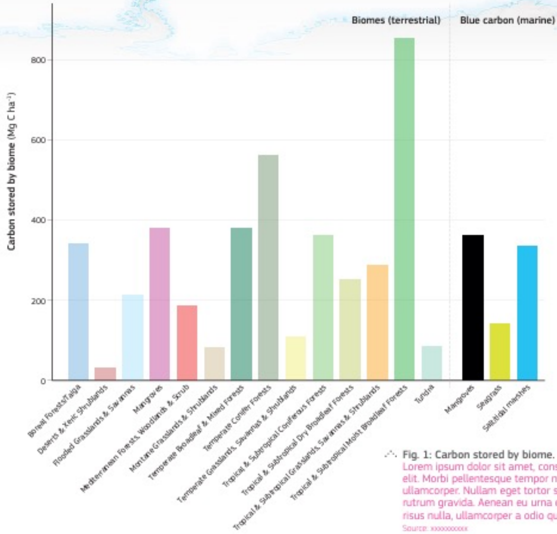
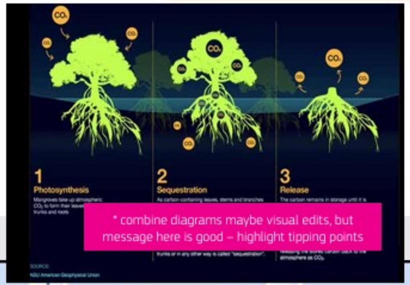


Fig. 1: Carbon stored by biome. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Morbi pellentesque tempor nunc pretium ullamcorper. Nullam eget tortor sit amet risus rutrum gravida. Aenean eu urna dolor. Phasellus risus nulla, ullamcorper a odio quis, euismod.
Source: xxxxxxxxx

Carbon cycling [Title?]

Carbon cycling takes place over different time scales. The **fast carbon cycle** involves exchanges between the atmosphere, soil, water bodies, and living organisms through processes like combustion, photosynthesis, respiration, digestion, and decomposition.

In the **slow carbon cycle**, the remains of organic organisms are compacted into sedimentary rock, trapping carbon for millions of years before it is released through processes like leaching, chemical weathering, and volcanic eruptions.



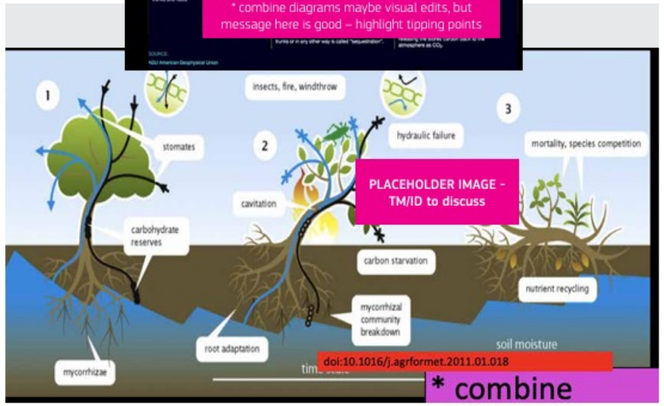
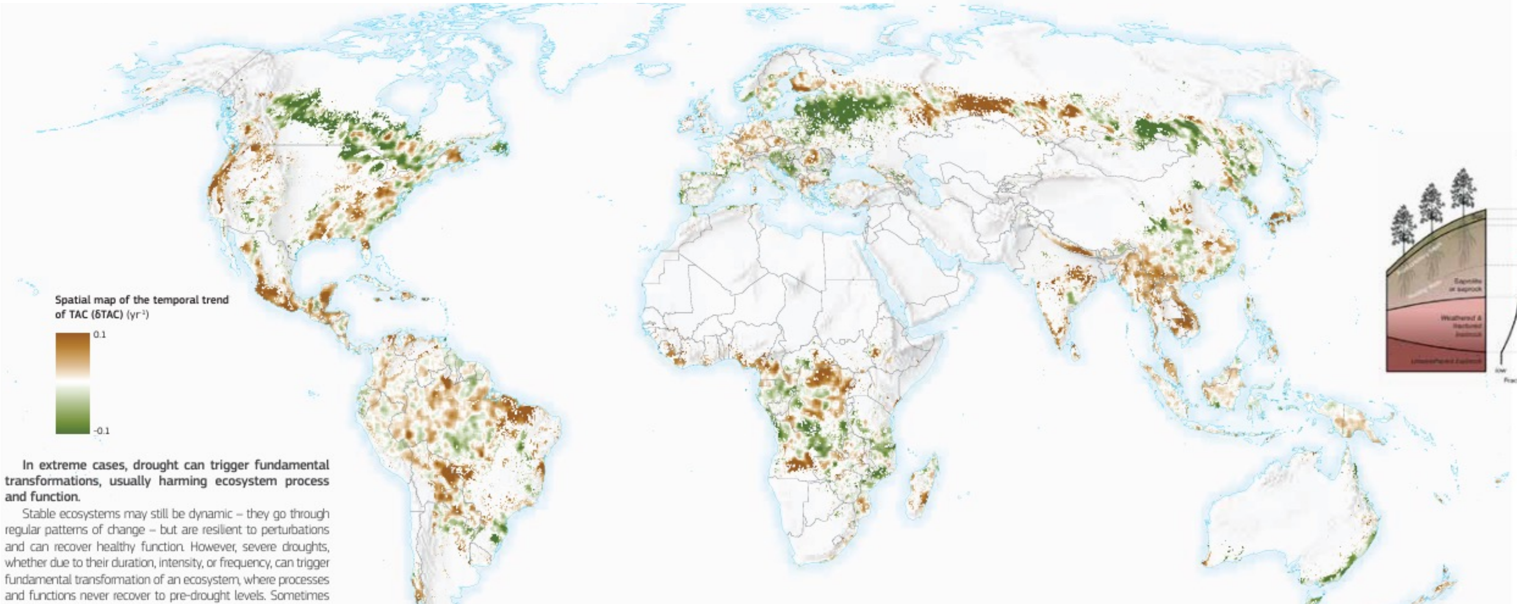


Fig. 2: Impact of drought on the carbon cycle. Interaction of drought and the carbon cycle, (1) before, (2) during, and (3) after a period of intense moisture stress, and the time scales involved in the response.
Source: Redrawn by LJ for the Global Drought Atlas, based on doi:10.1016/j.agrformet.2011.01.018

Ecosystems transformation



In extreme cases, drought can trigger fundamental transformations, usually harming ecosystem process and function.

Stable ecosystems may still be dynamic – they go through regular patterns of change – but are resilient to perturbations and can recover healthy function. However, severe droughts, whether due to their duration, intensity, or frequency, can trigger fundamental transformation of an ecosystem, where processes and functions never recover to pre-drought levels. Sometimes referred to as a regime change or tipping point, this process can result in ecosystem collapse and conversion. Usually, the new stable state has reduced ecosystem function (e.g., reduced carbon storage in drought-impacted wet soil ecosystems, bottom left) and can even create a feedback that increases drought occurrence (e.g. loss of forest microclimates, right).

The speed of these transformations can vary, particularly due to the lag in impact and recovery times associated with drought. However, as systems approach a tipping point beyond which recovery is not possible, they often experience a **critical slowing down**, characterised by longer recovery times and lower resilience (below). Changes in land-atmosphere interactions related to drought can be both a cause and effect of ecosystem transformation (right), as changes to land cover impact processes like evapotranspiration, relative humidity, solar radiation, and precipitation.

Map 1: Spatial map of the temporal trend of TAC (δTAC).
Spatial map of the temporal trend of TAC (δTAC). Positive δTAC values (for example, tropical forests) suggest a reduction in recovery rates and thus a decline in resilience, and vice versa for negative δTAC values (for example, boreal forests).
Source: https://www.nature.com/articles/s41586-022-04959-9

Figs. 1a and 1b: Drought impacts on wet soils.
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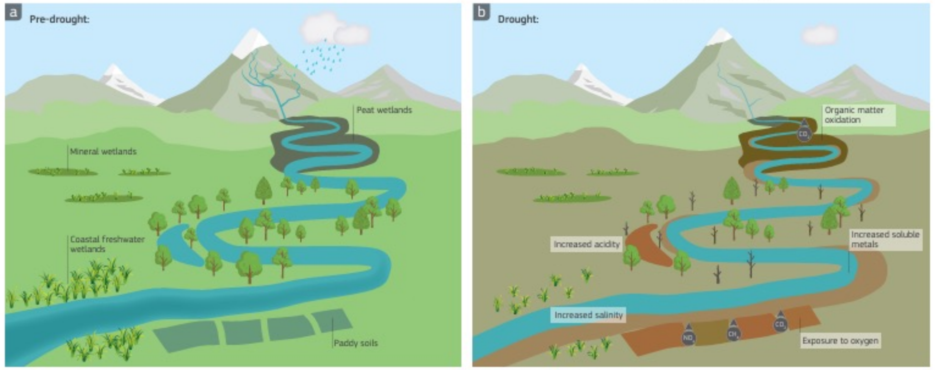
Source: Redrawn by LJ for the Global Drought Atlas, based on https://www.sciencedirect.com/science/article/abs/pii/S0012825220304335?via%3Dihub



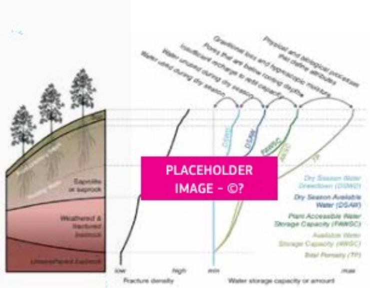


Fig. 3: Conceptual model of critical zone architecture (left), fracture density (middle), and their relation to changes in subsurface attributes (right).
The **critical zone** refers to the region just below and at the Earth's surface that sustains nearly all life on the planet. This includes the subsurface from the top of unweathered bedrock through to the vegetation canopy. The architecture of the subsurface critical zone and its consequent water storage capacity (left) can be particularly important for sustaining vegetation and fungal networks – and by extension, the entire ecosystem – through drought.
Source: https://wires.onlinelibrary.wiley.com/doi/10.1002/wat2.1277

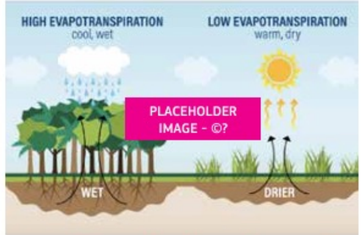


Fig. 2: Non-carbon Effects of Forests - Evapotranspiration.
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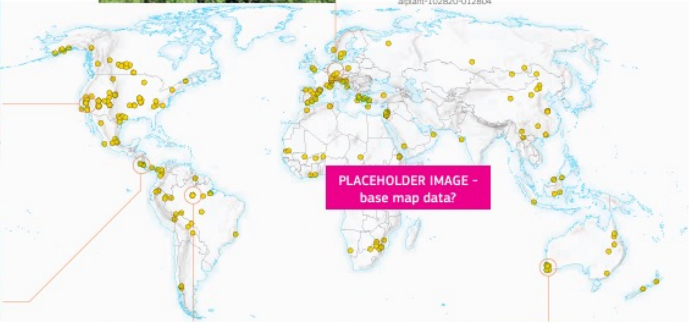
Source: https://www.wri.org/insights/restoring-degraded-forests-temperature-precipitation-effects

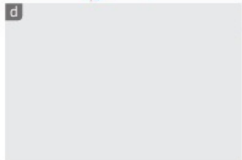
xxxxx, xxxx, Germany.
Source: Henrik Hartmann.

Map 2: Published observations of elevated tree mortality in response to drought and heat (yellow dots).
The forest cover shown here includes only canopies 5 m or taller plotted and taller canopies in increasingly darker green. The yellow dots show published observations of elevated tree mortality in response to drought and heat.
Source: https://www.annualreviews.org/content/journals/10.1146/annurev-arplant-102820-012804

Sierra National Forest, California, USA.
Source: Region 5 Photography (Pacific Southwest Forest Service, USDA) on Flickr.



xxxxx, xxxx, Costa Rica.
Source: Jennifer Powers.



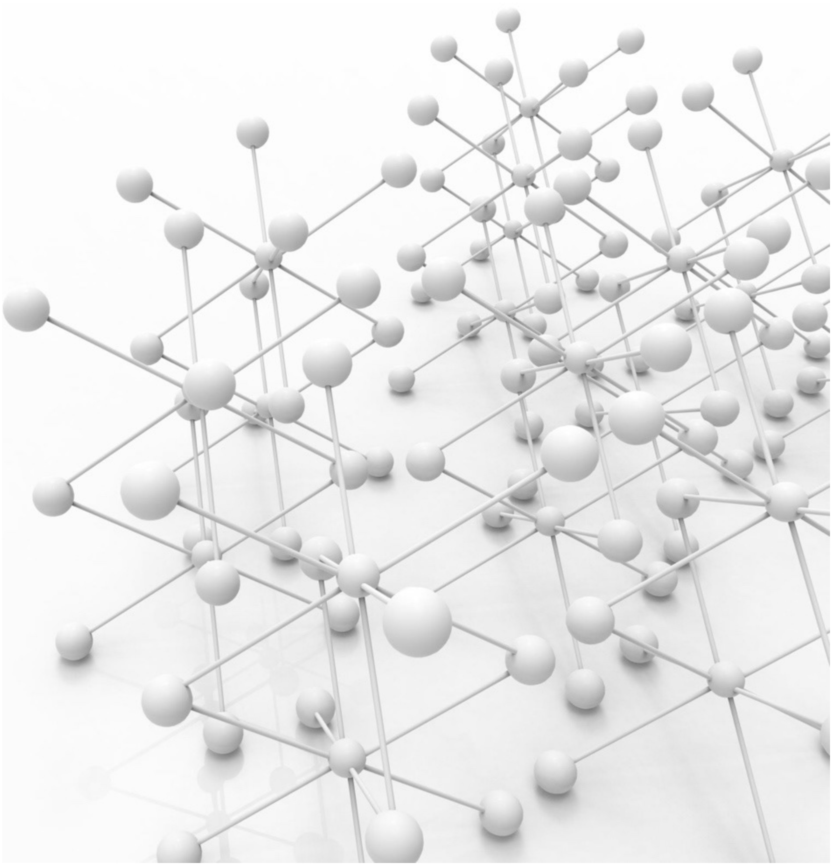
xxxxx, xxxx, Amazon.
Source: xxxxxx.

xxxxx, xxxx, SW Australia.
Source: Katinka Ruthrof.

2.6 Impacts of interconnected systems

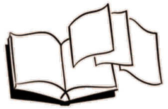
Cross-sectoral perspective & compound effects

Interactions of drivers and impacts across sectors (building on sectoral conceptual models). Includes a spread on land degradation



[~5-7 pages]

Part 3: Examples from the world



[~30 pages]

- Exemplary cases describing regional risks and impacts of global relevance. The regional lens is used to illustrate sectoral and cross-sectoral impacts and risks, action taken to mitigate the impacts.
- This section includes involvement of local experts

Horn of Africa
Agriculture, food security

California
Water supply, snow drought

Part 3: Examples from the world

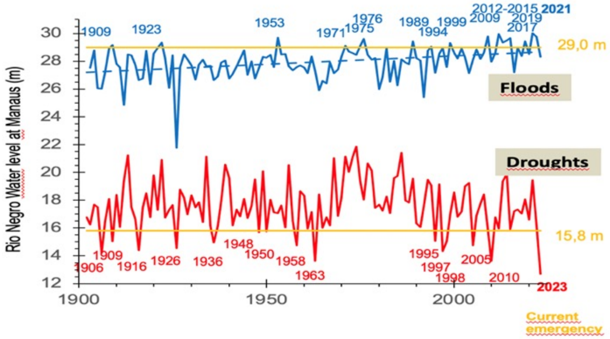
[~30 pages]

- Regions
  - Central Asia / Afghanistan
  - Russia
  - Southern Asia / India / Pakistan
  - Southeast Asia / Cambodia-Laos
  - East Asia / China
  - Australia
  - North Africa
  - Middle East / Syria
  - Horn of Africa
  - West Africa
  - Southern Africa
  - North America: Western U.S., impacts on Tribes
  - Central America
  - South America: Amazon, Andes, La Plata, NE Brazil
  - Europe

- Themes
  - Urban water supply
  - Small island developing states: Caribbean, Asia Pacific

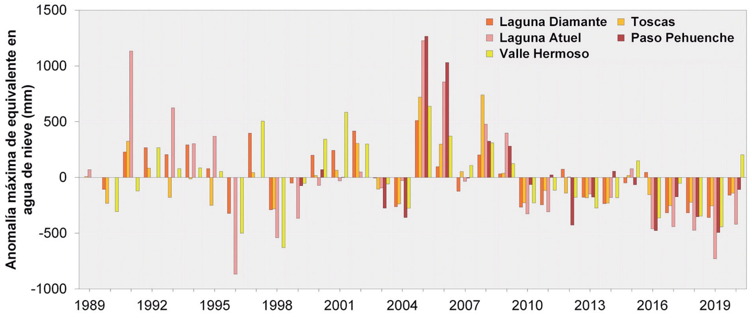
South America

Amazon Basin, 2023

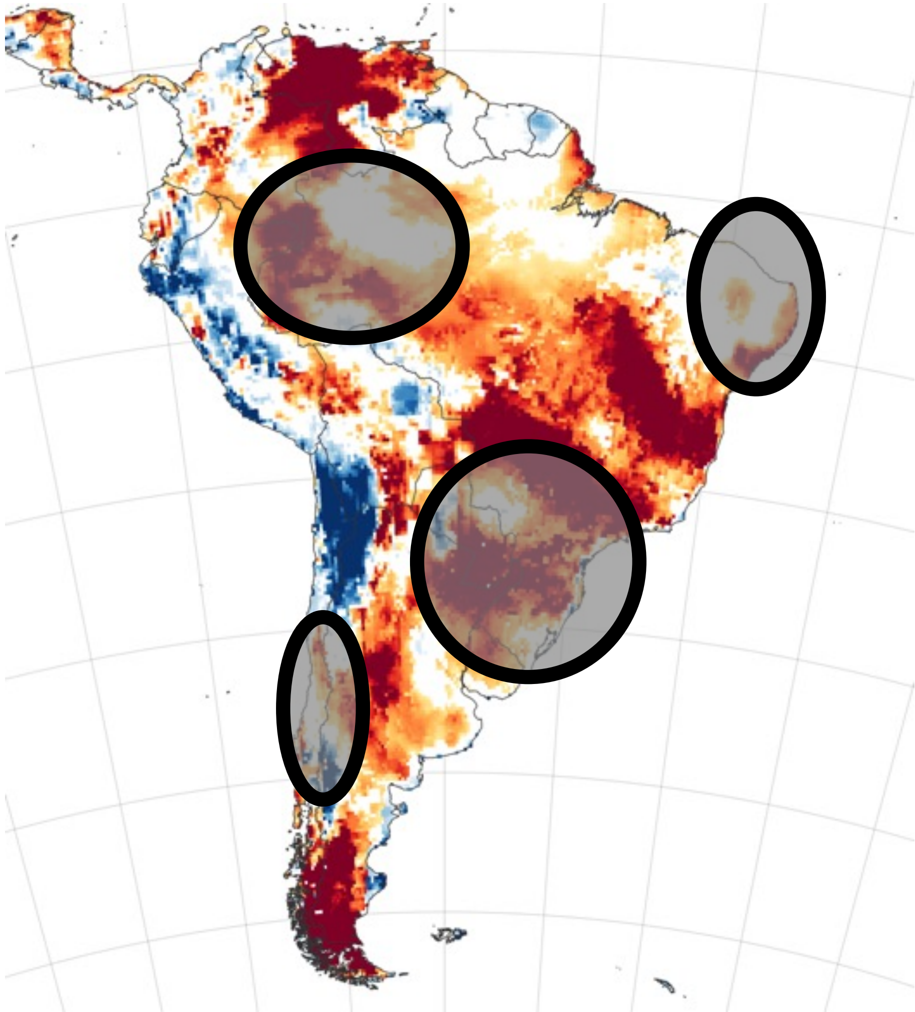


- Increased mortality of fish and aquatic mammals,
- Drinking water scarcity
- River transportation disruption
- Increased risk of waterborne disease,
- Wildfire increase

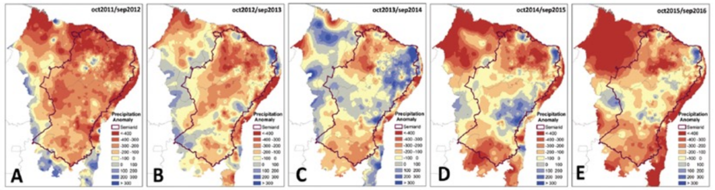
Extratropical Andes, since 2010



- Agricultural Emergency in 226 communes
- domestic use restriction
- hydropower production losses
- sociopolitical disputes
- tourism losses

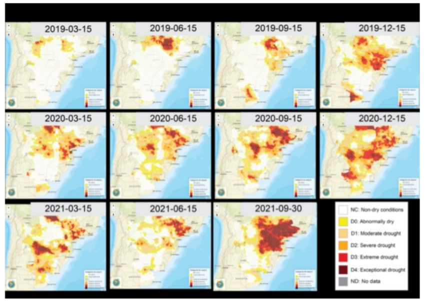


Northeastern Brazil, 2010-2017



- 33.4 million people were affected
- Economic losses over US $ 30.0 billion

La Plata Basin, 2019-2023



- Hydropower generation
- River navigation in the five countries
- Argentina lost 3.3% of GDP and a 21.8% reduction in agricultural exports

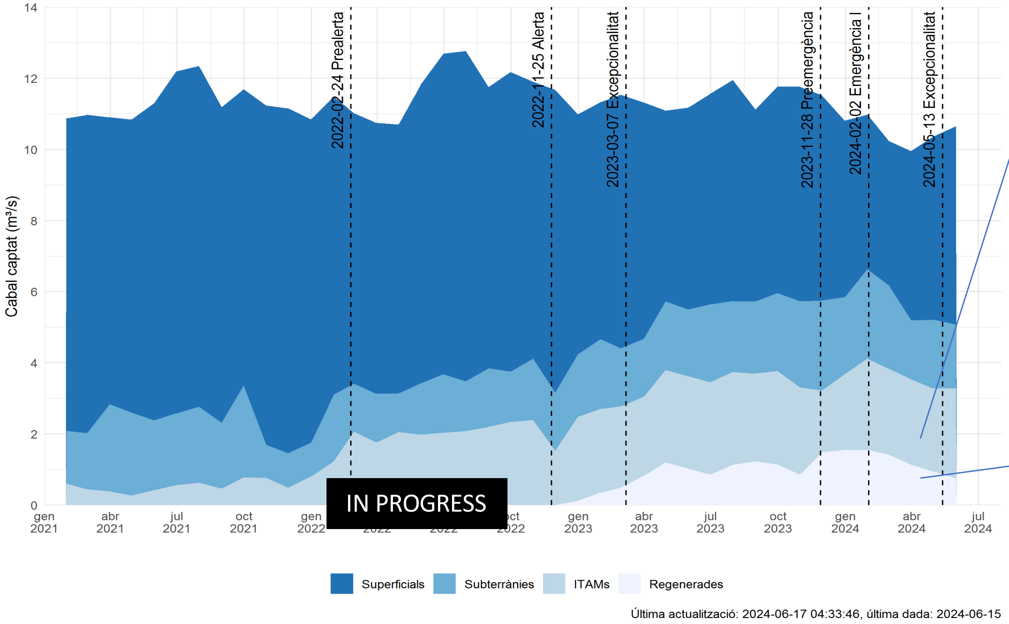
Barcelona drought 2021-2024

This church in Sau Reservoir, usually completely covered by water, became an iconic image of the drought.

A **Drought Management Plan,** approved in 2020 defines:

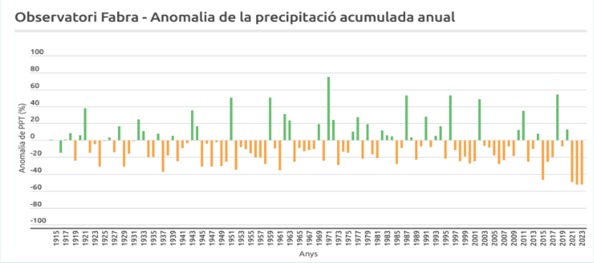
- three drought stages
- mitigation actions and water restrictions in all sectors

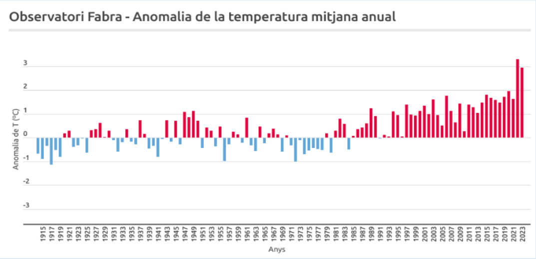
Evolution of the water sources for Greater Barcelona's water supply network



A key strategy in managing the drought has been the mobilization of alternative resources, thereby conserving water in the dams.

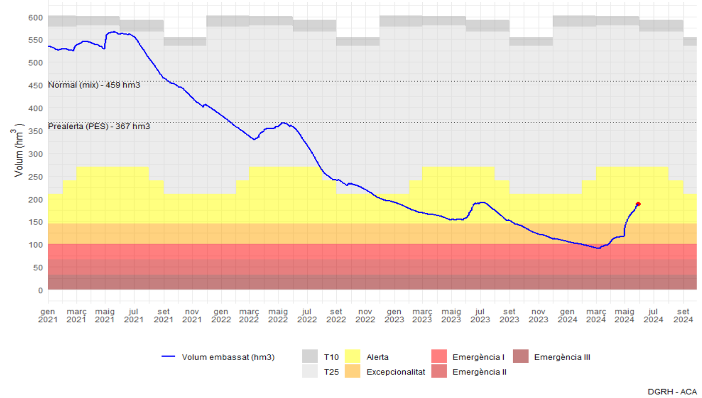
Rainfall and temperatures anomalies

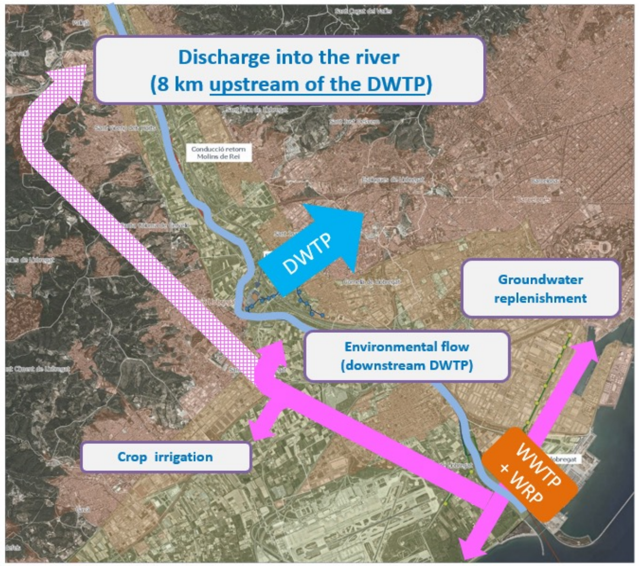




Llobregat's Seawater Desalination Plant (photo by Aigües Ter Llobregat)

Evolution of the water volume in the reservoirs





Water Reuse Scheme from the El Prat de Llobregat WWTP.

Water reuse:

- Reuse for irrigation
- Managed aquifer recharge
- Indirect drinking reuse

Part 4: Managing and adapting to drought risk

[~20 pages]

4.1 Approach and frameworks

Reactive drought risk management

Measures include

- Emergency food and drinking water assistance
- Subsidies for restoring crops and livestock
- Relief funds

Proactive drought risk management and adaptation

Measures include

- Climate smart irrigation
- De-stocking of livestock & adjusting seasonal cropping patterns
- Introducing seasonal micro-credit and crop insurance schemes

Prospective drought risk management and adaptation

Measures include

- Public awareness campaigns and pricing schemes to reduce water demand
- Diversification of renewable energy systems to reduce dependence on hydropower
- Land-use planning to achieve Land Degradation Neutrality

Managing impacts — **Reducing risks** — **Avoiding future risks**

Part 4: Managing and adapting to drought risk

[~20 pages]

4.2 Managing and adapting to drought risks: experiences, measures and options

Success stories: from local to global

- *Story 1:* ***From individual/community level*** *(e.g. water management for subsistence agriculture / cash crop production)*

- *Story 2:* ***From a sectoral perspective*** *(e.g. water use in the energy sector, covering one or multiple of the sectors from Part 2)*

- *Story 3:* ***From the national perspective*** *: (Establishing National Drought Management Plans, lessons from the Dominican Republic"*

- *Story 4:* ***From international perspective:*** *e.g. adoption of water framework and drought management plans*

Part 4: Managing and adapting to drought risk

[~20 pages]

4.3 Overview of drought management and adaptation measures

- Drought risk management & adaptation measures
- Managed groundwater recharge & conservation
- Land regeneration & agroforestry measures
- Improved water retention infrastructure (green, blue & grey)
- Lake, reservoir & wetland management
- Improved irrigation efficiency
- Drought resistant crop varieties & adjusting cropping & livestock patterns
- Drought monitoring & early warning systems
- Micro-insurance for smallholder farmers
- Wastewater reuse & desalination
- Community- based water resource management
- Migration away from drought impacted area
- Pricing & trading schemes for water usage
- …

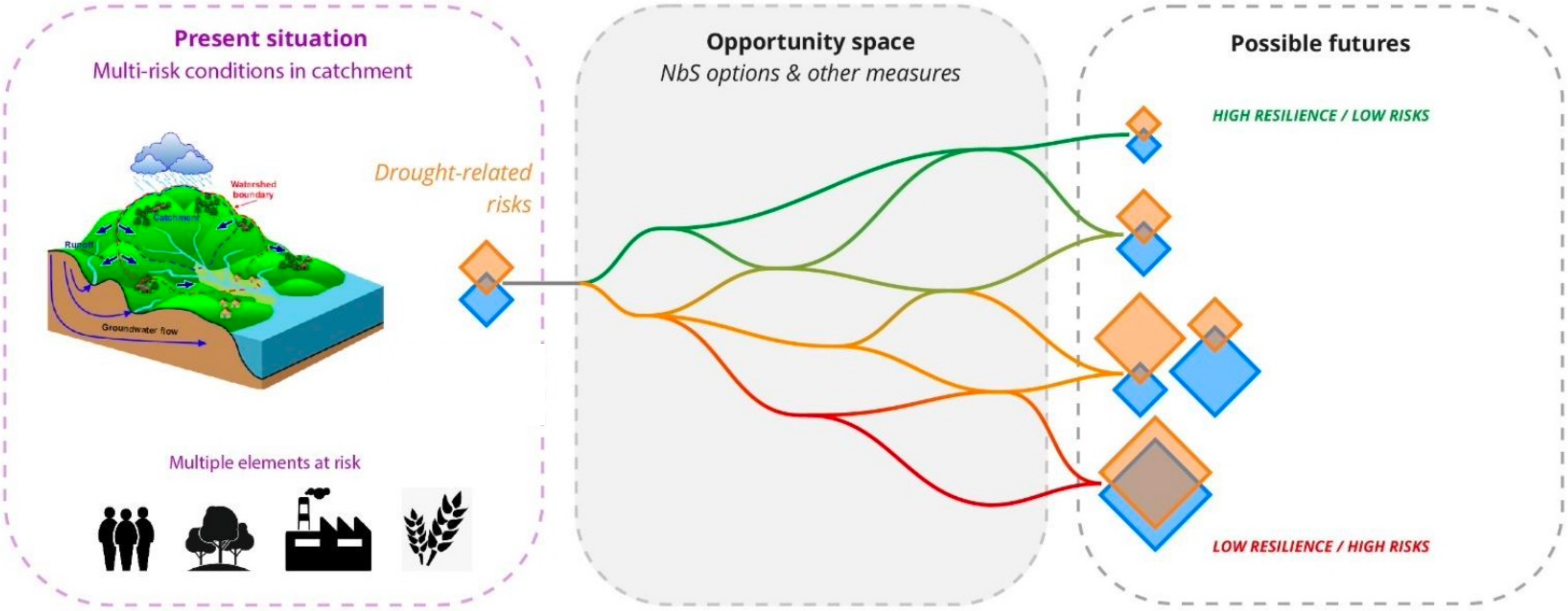
}

- Description
- For which main sectors
- Co-Benefits
- Trade-offs
- Enablers
- Barriers
- Scalability & transfer

Part 4: Managing and adapting to drought risk

[~20 pages]

4.5 Pathways towards tackling systemic drought risk and building resilience



Part 4: Managing and adapting to drought risk

[~20 pages]

4.5 Pathways towards tackling systemic drought risk

Box 4.1: Gender and drought risks

Box 4.2: Early warning systems for drought

Box 4.3: Nature-based solutions for drought

Box 4.4: Shared solutions for hydrological extremes

Box 4.5: Transboundary drought risk management – an opportunity for collaboration

Timeline

Now
Inception Report
Layout Version (PDF)
Progress meetings
KO Meeting
FirstDraft
Final Draft
Print
UNCCD Conference of Parties 16th session | COP16
14 Dec 2024
Monthly
30 Sept 2024
2-13 Dec 2024
14 Feb 2024
31 July 2024
31 Oct 2024

Discussion

- Anything to correct/emphasise?

- Anything missing?

Thank you

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