



Environment:  
European Law and Policies  
Water Scarcity  
Examining Impacts Around the World

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# Introduction

- Water geopolitics
- Definitions (water scarcity & stress)

# Common Issues and Impacts

# Case studies

- Yemen
- Australia
- Spain
- Canada

## Outline

# The importance of water

***“When the well’s dry, we know the worth of water”***

Benjamin Franklin (1706-1790)

## **Water is essential for:**

- The existence of human and other life forms
- Manufacturing
- Agriculture
- Commerce
- Economy
- Many types of energy (e.g. hydroelectric energy)

## **It can also be:**

- Polluted
- Desalinated
- Recycled
- A force of life or destruction

# The geopolitics of water

The issues of water stress and water scarcity are key forces in geopolitics...

Water scarcity already affects 2 billion people in more than 40 countries

Water scarcity: North Africa, Israel, Jordan

Developing countries

1 billion people do not have access to clean water

2.4 billion people do not have access to sanitation

Problems of drought, floods, extreme weather events

China and India host 40% of the world's population but have 10% of the world's freshwater

China: 60% of groundwater is considered polluted

India: Due to climate change and water mismanagement for agricultural use is expected to have water difficulties from 2025 and water scarcity from 2050

# Definitions

## **Groundwater resources:**

Water found in underground aquifers

## **Land subsidence**

The settling or sinking of land stemming from movement of underground material

## **Water scarcity:**

Less than 500 cubic meters of water per person per year (500 m<sup>3</sup>/capita/year)

## **Water stress:**

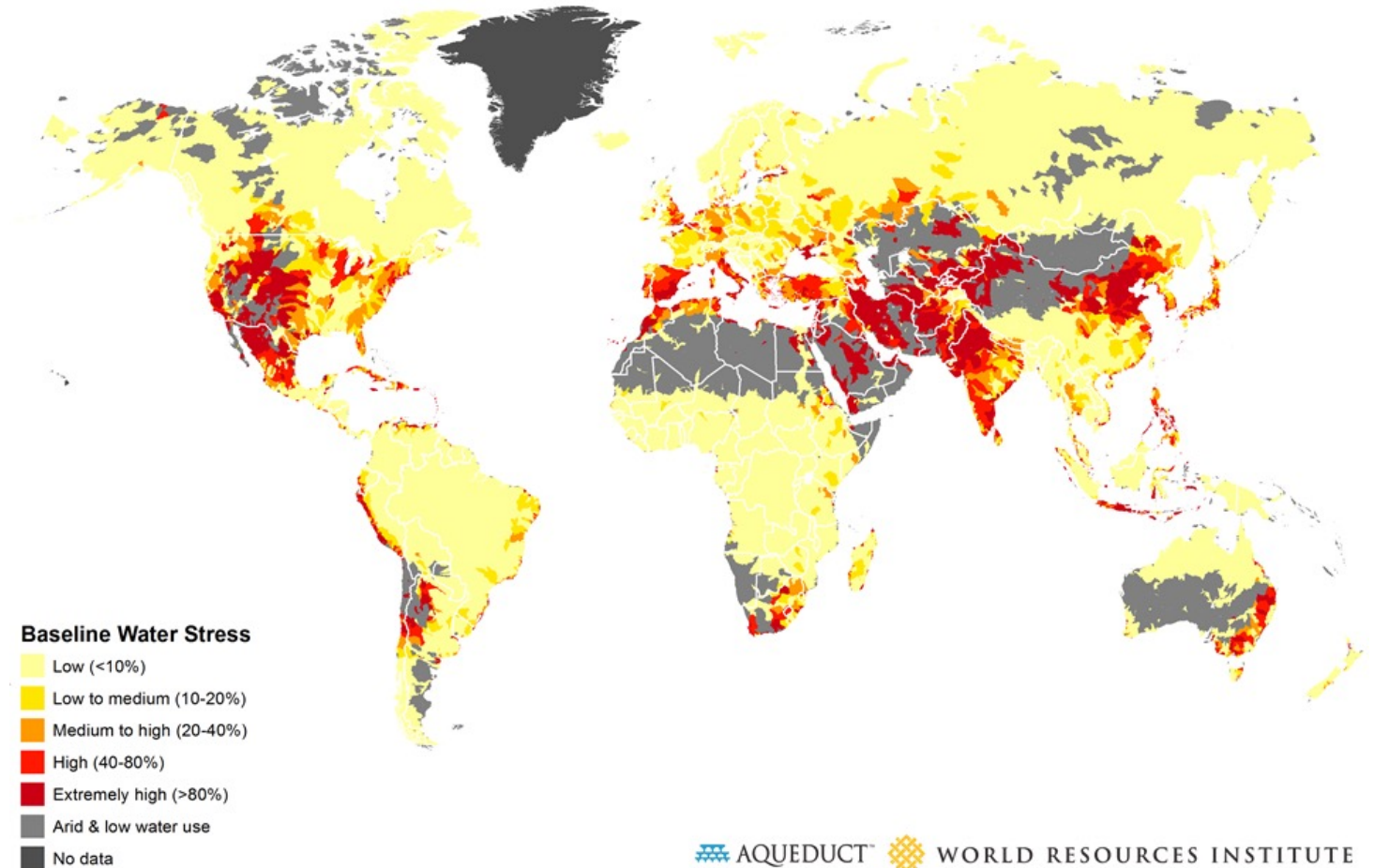
Situations in which water availability poses a serious constraint on human activity. By some definitions, this amount equals less than 1,000 cubic meters per capita per year (1,000 m<sup>3</sup> /capita/ year)

# Water stress effects

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- Reduced food and livestock production
- Population movements
- Additional costs of living
- Famine/starvation
- Political stress

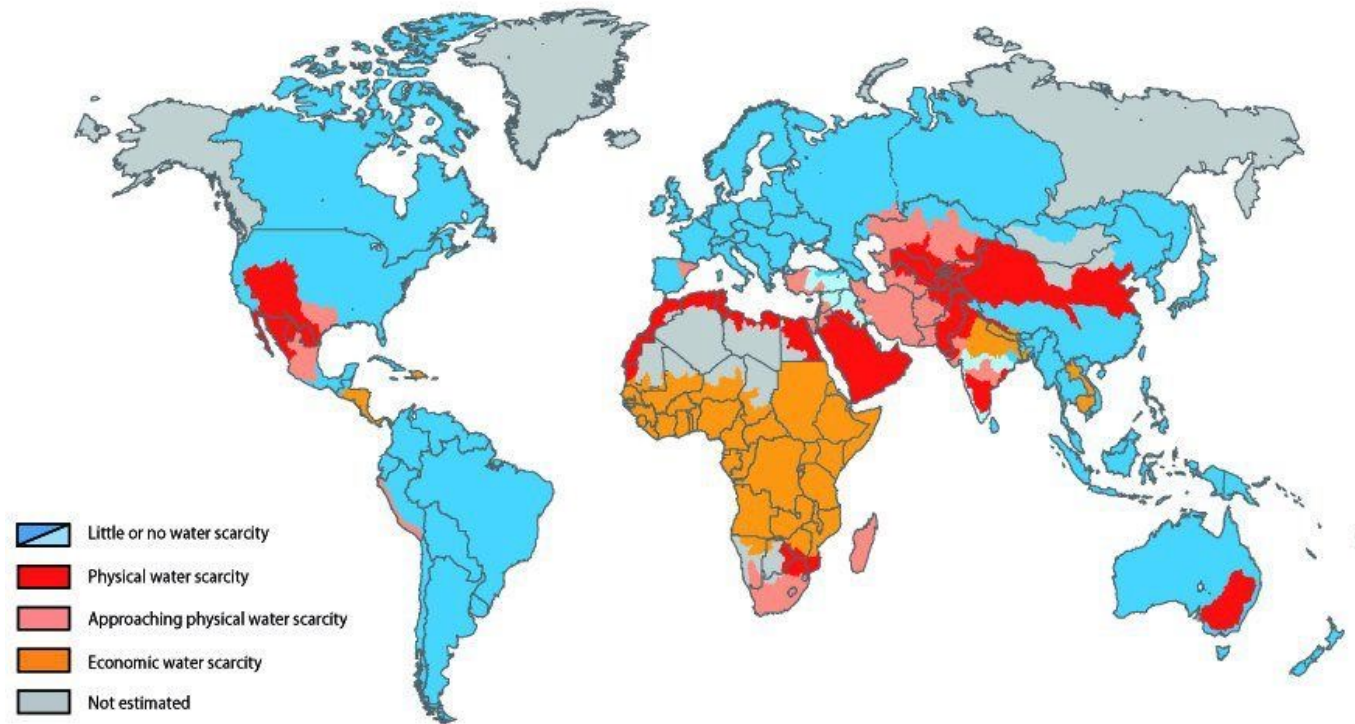
## WATER STRESS AROUND THE WORLD



# Water scarcity effects

- Agriculture
- Tourism
- Industry
- Environment (wetlands dry up, sterilization of rivers, springs, etc.)

Areas of physical and economic water scarcity



Source: IMWI report, Insights from the Comprehensive Assessment of Water Management in Agriculture, 2006 / p8

<https://worldwaterexchange.com/interactive-world-map-visualises-water-scarcity-around-the-globe/>

# Water availability

## **Common issues**

- Geographic terrain and climate
- Public infrastructure
- Strength of political institutions
- Farming practices & water management techniques
- Public attitudes

## **Other factors**

- Population growth
- Public health issues (pollution & disease epidemics)
- Industrial growth



## Extreme effects

In prolonged drought, mass migration may occur in areas where jobs or agriculture are more abundant

(e.g. "Dust Bowl" USA)

Hunger and famine are possible outcomes in areas affected by poverty or severe water scarcity



Environment:

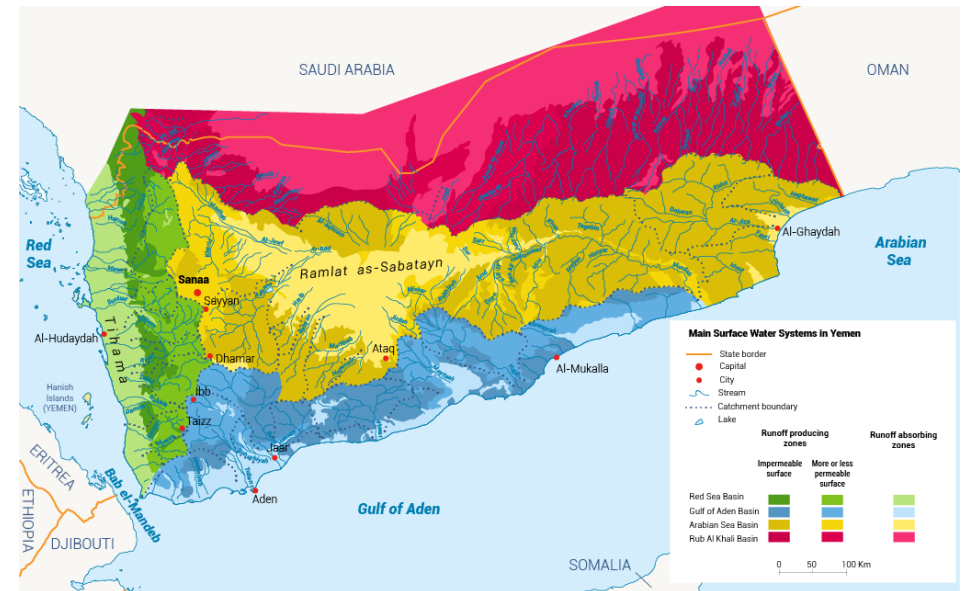
Environment: European Law and Policies

# Yemen

## A Worst-Case Scenario

- High growth rates of the world population
- Higher rate of depletion of water resources in the Middle East
- Water availability is  $80 \text{ m}^3 / \text{capita} / \text{year}$ , which is much lower than the World Bank water level ( $1,000 \text{ m}^3 / \text{capita} / \text{year}$ )
- Sanaa is the only capital that can run out of water in the next decade
- The combination of high population growth and depletion of water resources has contributed to a catastrophic crisis

Main surface water systems



<https://water.fanack.com/yemen/water-resources-yemen/>

# Yemen in history

Yemen – now one of the world's poorest countries – was once a paragon of water engineering.

Advanced irrigation and water management techniques from times of antiquity

Great Dam of Marib – an engineering marvel of the ancient world

Water supply is entirely internal – no external dependencies

Transition period in recent history:

1970s: Agricultural expansion required more groundwater for irrigation

1980s: Yemen became oil-producing country, leading to creation of cash economy

1980s: With cash economy, demand for qat – a highly water intensive narcotic grown in Middle East – shot upward



# Yemen by numbers

~2.1 billion m<sup>3</sup> of renewable water resources per year available

Groundwater: About 70% of Yemen's overall water supply

Groundwater recharged by irregular surface flows of wadis

Most important source of water

Water deficit: Yemen withdraws 3.5 billion m<sup>3</sup> in freshwater sources/year

Most aquifers overexploited

Saltwater intrusion and pollution in many areas

<https://www.arcgis.com/apps/Cascade/index.html?appid=d2f17327e5b14f1c88a236912a5b8f86>

# Yemen today

Extreme water scarcity: Population lives on only 86 m<sup>3</sup>/capita/year

High annual population growth – from 3% in 2001 down to about 2.3% in 2014

Agriculture commands nearly 90% of all water withdrawals

Qat accounts for about 20% of all irrigated acres

By some estimates, qat takes up half of all agricultural withdrawals

Conclusion: Large parts of the country could literally run out of water within the next decade if stay the current course



# Yemen's conflicts

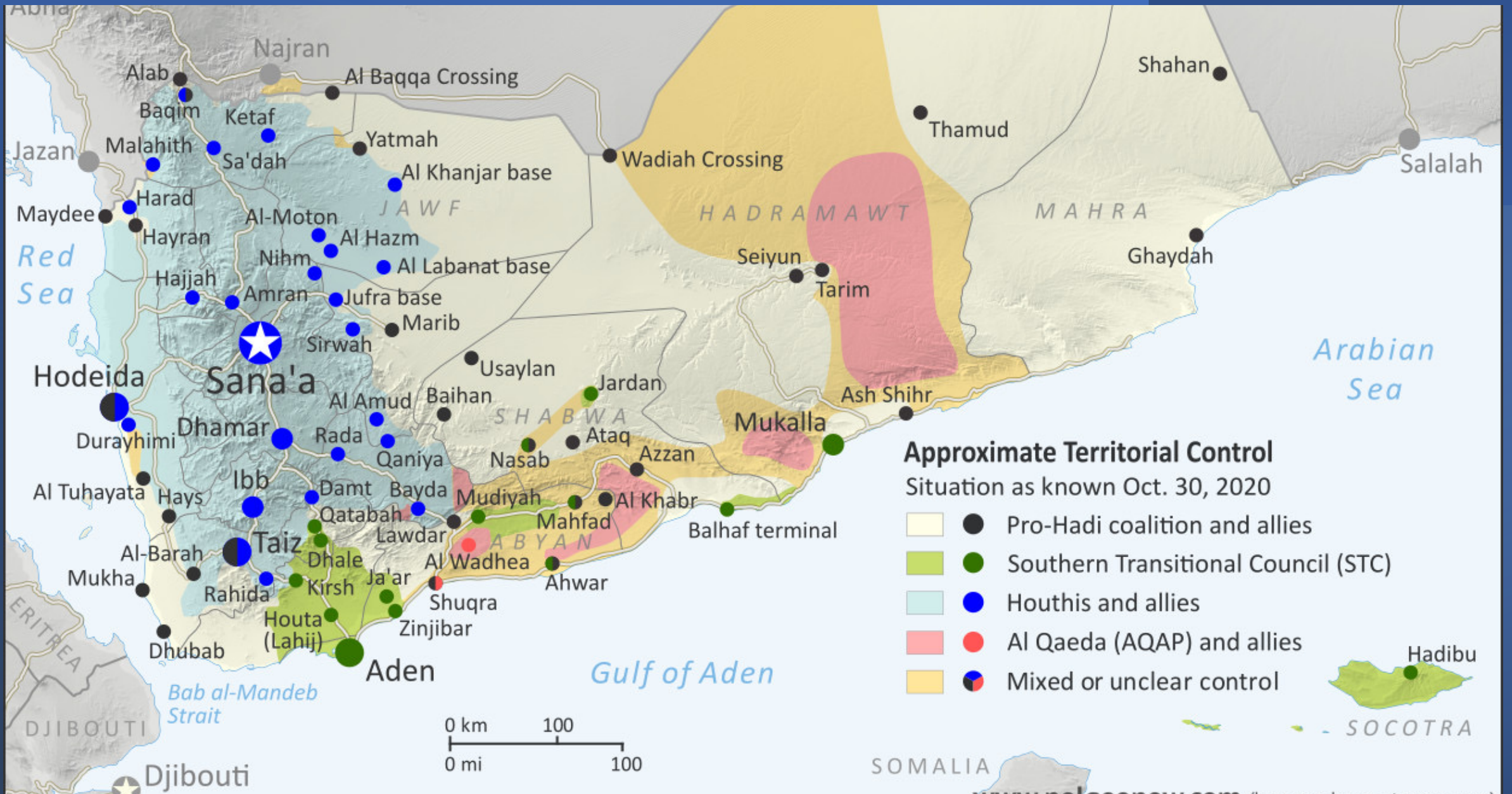


Yemen today is perhaps best known for the civil conflict raging within its borders

Conflict is not the source of – but adds to – water stresses in the country

Control of water resources is now a strategic asset for warring parties

Political instability further strains country's ability to maintain existing water infrastructure or invest in new water sources



# Yemen's outlook

**Increasing strains on municipal water supplies** to support growing population

Water supplies lost to **dilapidated infrastructure and inefficient irrigation**

**Constraints on water supplies** will hurt industrial growth – particularly in energy sector

**Economic impacts** of failure to address water management issues will become more evident

Estimated 1.5% of GDP lost to groundwater depletion

~2.4% of GDP is lost due to poor water sanitation (U.N. Development Program)

**Outlook for political stability: Poor**

<https://www.undp.org>



# Potential options

Key solutions available for Yemen:

	THEORETICALLY POSSIBLE?	WITHIN GOV/ ECON MEANS?
Update infrastructure	✓	✗
Control well drilling/management	✓	✗
Implement conservation policies	✓	✗
Invest in/implement desalination	✓	✗

# Expectations

Dire outlook for Yemen:

- Onus for change falls to local governments – often corrupt, inefficient and poorly funded
- Water withdrawals likely to exceed annual renewable inputs
- Water scarcity contributing to unrest

Other countries to watch (withdrawals exceed annual renewable inputs):

- Jordan
- Egypt
- Parts of Palestinian Territories

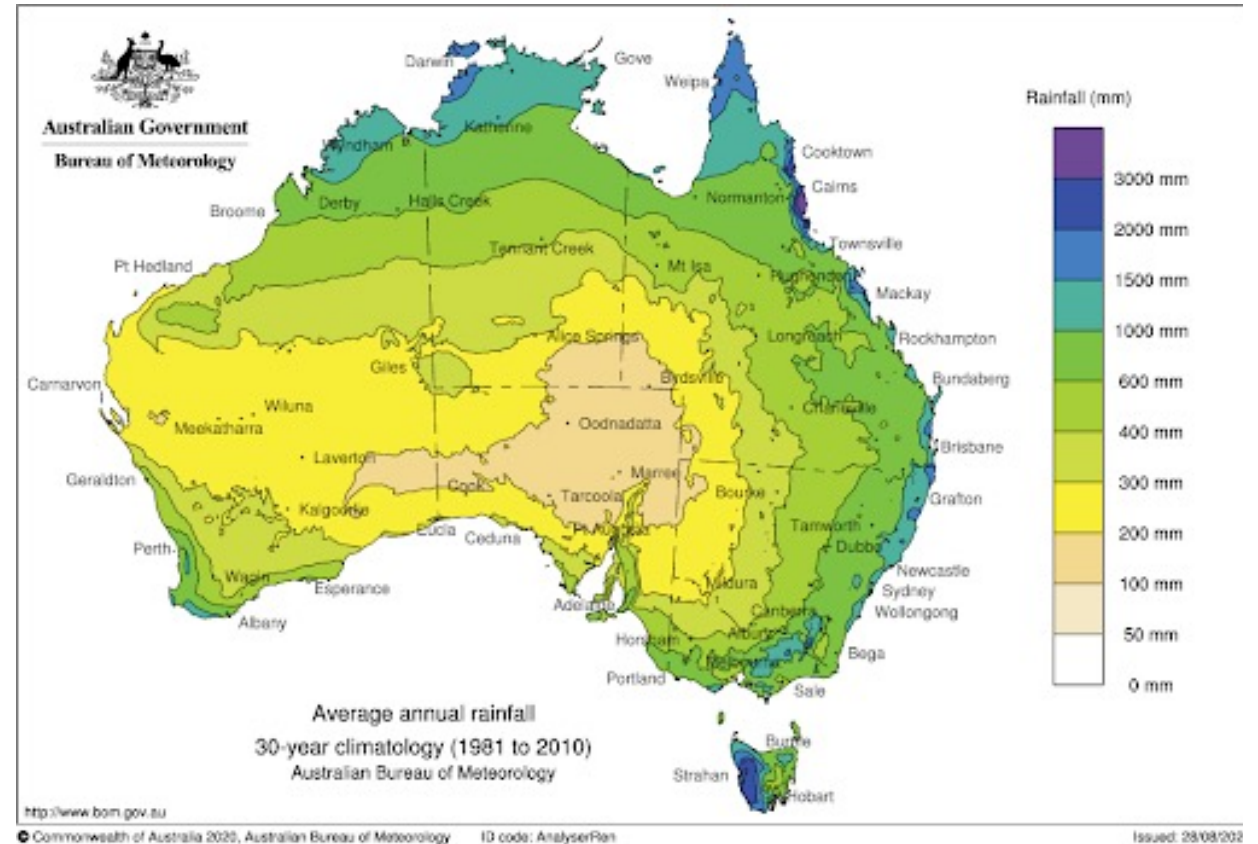
Prolonged instability would damage ability to implement water management strategies

Near-term changes needed for long-term impact

# Australia: *A Virtual Water Exporter*

## Challenges

- Arid climate – already driest inhabited continent
- Domestic water consumption levels
- Crop exports – mainly to China
- Virtual water exporter
- Water intensive agriculture and trade goals



# Australia by numbers

21,077 m<sup>3</sup> /capita/year – relatively high, but not evenly distributed

Overall consumption - roughly 1,200 m<sup>3</sup> /year

Total withdrawals = ~23 billion m<sup>3</sup> /year

Agriculture - ~74% of the total

Uses more water as percentage of total use than other developed countries, although is comparatively efficient

Uzbekistan – 56 billion m<sup>3</sup> /year – 90% agriculture

Pakistan – 184 billion m<sup>3</sup> /year – 94% agriculture

Areas with high agricultural output = greater water stress

**Murray-Darling Basin = >40% value of country's agricultural production** 

# Murray-Darling Basin



# Agriculture in focus

Murray-Darling Basin:

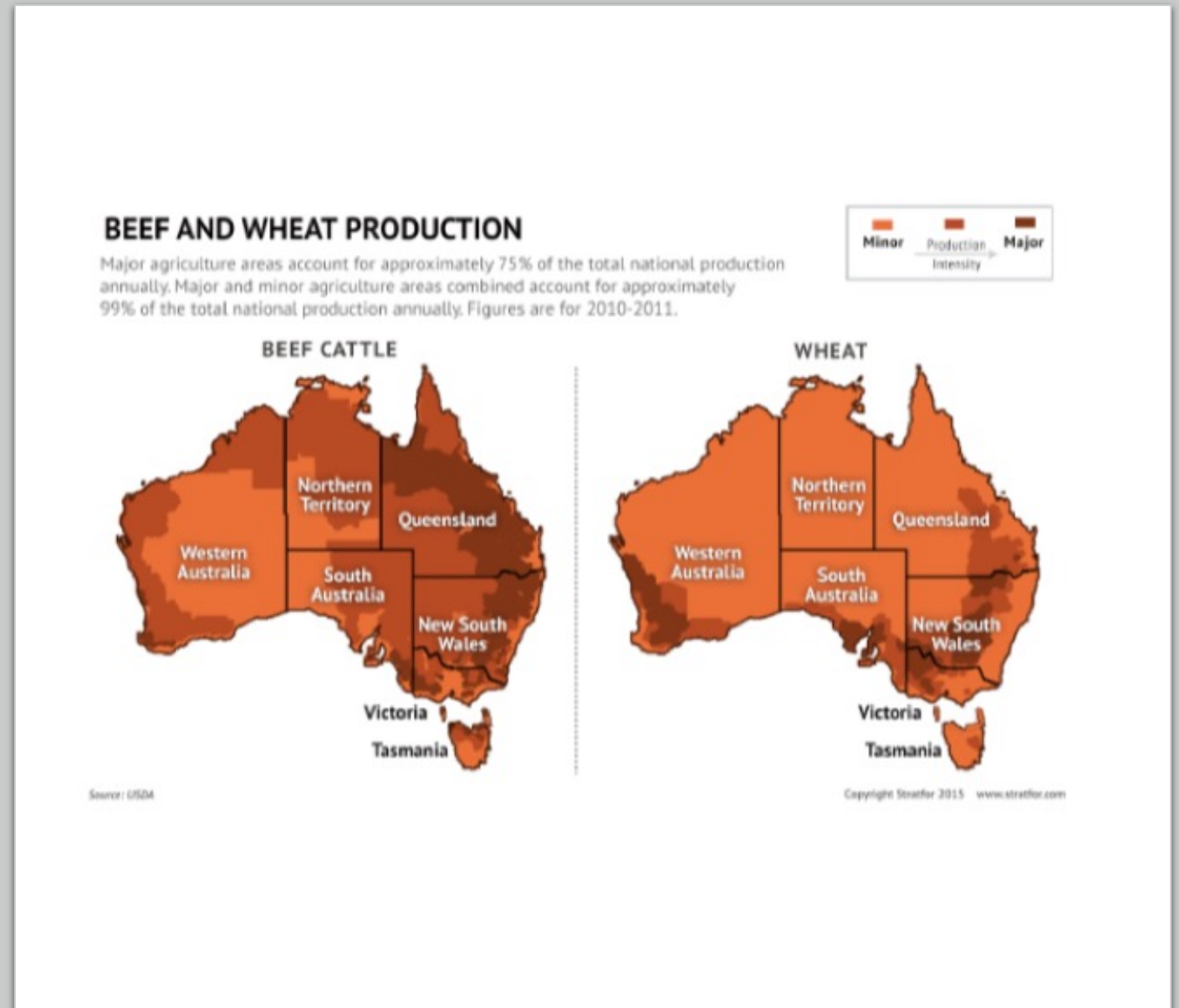
New South Wales+Victoria produce:

- 48% of Australia's corn
- 31% beef
- 43% wheat
- 75% dairy cattle productions

Water resources highly stressed:

- Groundwater strains showed mid-1990s
- Severe drought, 2001-2007
- Environmental degradation of rivers
- 1/3 of rivers substantially modified

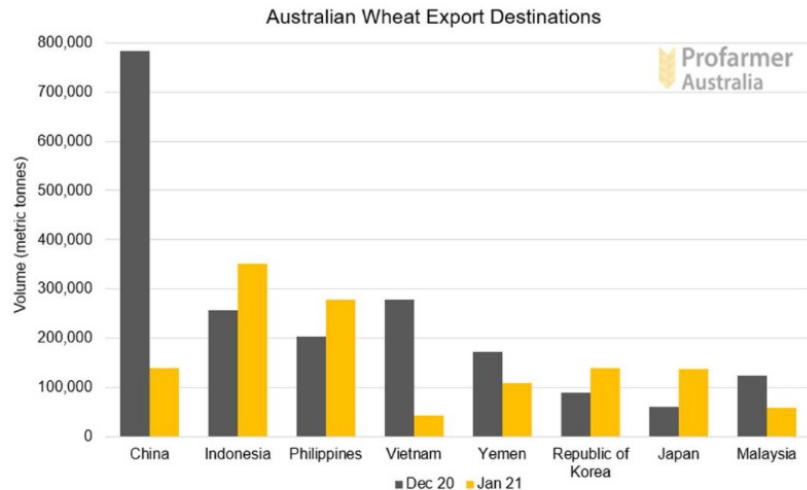
- In 2018–19, Australia produced approximately 2.4 million tonnes carcass weight (cwt) of beef and veal
- In 2019–20, 3 million grainfed cattle were marketed (feedlot turnoff), equal to 36% of all adult cattle slaughtered
- In 2019, Australia exported 76% of its total beef and veal production
- The value of total beef and veal exports in 2019 was A\$10.8 billion



# China's role

## China is destination for ~1/3 of Australia's food exports

- Growing relationship: FTA terms agreed November 2014, "Most Favored Nation" trade status secured March 2015
- Geographic proximity makes Australia key food supplier
- Removal of beef and dairy tariffs gives Australia additional advantages



## China invests heavily in food security strategies:

### Land ownership abroad

- Northern Territory, Queensland – highest percentages and volumes of foreign-owned land in Australia
- Mostly not dependent on Murray-Darling Basin

### Focus of Chinese investments in Australia:

- Beef and veal
- Sugar mills
- Seed companies
- Grocery distributors

**Australia is “virtual water exporter” due to significance of food/crop exports**

# Expectations

Australia will face consistent challenges in coming years:

- ✓ Drought conditions more prevalent
- ✓ Reduced water resources to supply domestic population
- ✓ Growth of food exports = virtual water exports

Continued focus on water management policies vital for Australia



# Spain: A study in desalination

## *The rain in Spain*

...makes it one of Europe's driest countries, on the whole

20th century - Limited water resources encouraged infrastructure development

Hydropower for electricity (some resources shared with Portugal)

Irrigation for agriculture

1,300 dams – world's highest percentage of reservoirs per million people

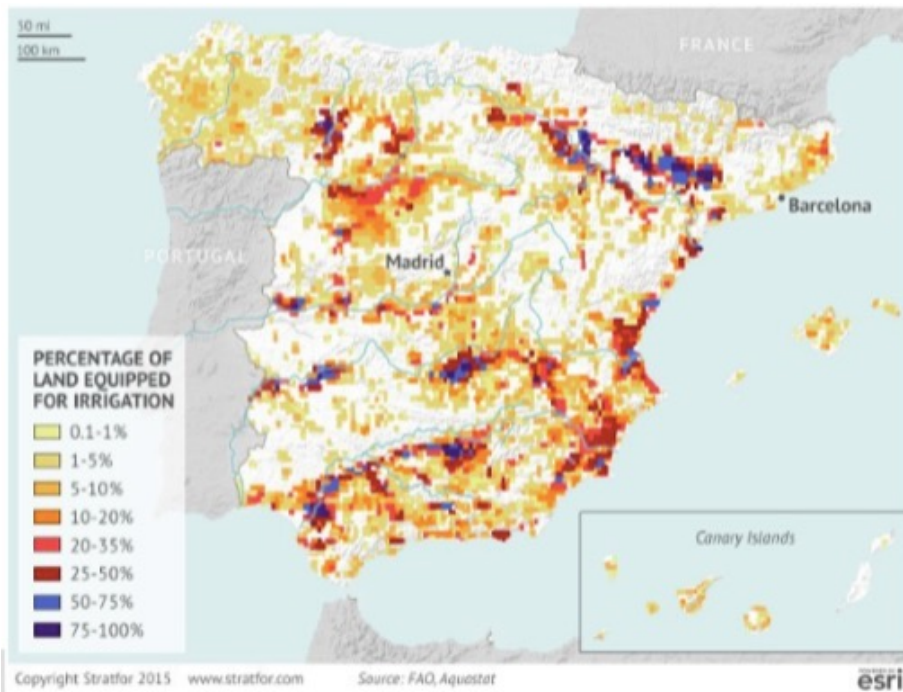
Snapshot today:

Agriculture = 64% all freshwater withdrawals

Irrigation key to farming sector

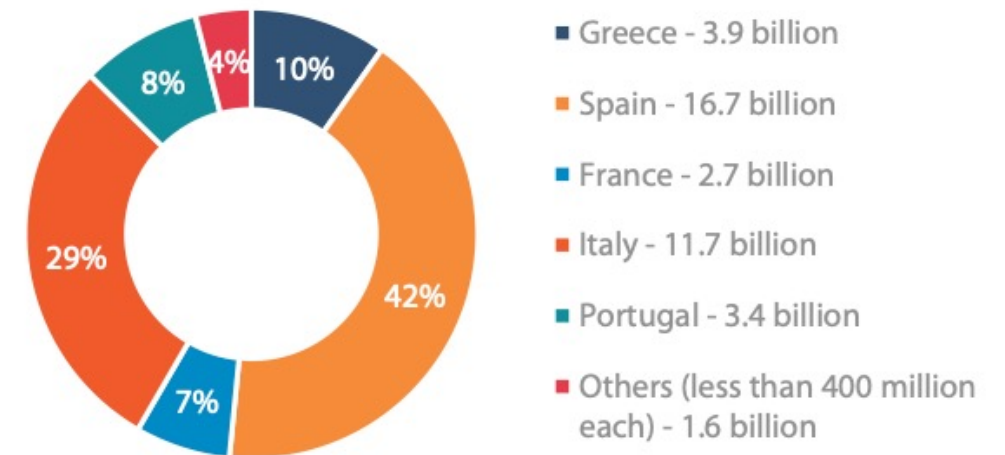
Irrigated acres produce disproportionate yields to total agricultural output – and ratio likely continue to grow

# Irrigation in Spain



# Irrigation in EU

Figure 1 – Volume of water used for irrigation in the EU in 2010 (% of total cubic metres)



Source: Eurostat, [Farm structure](#), 2010.

# The country under stress

Hotter, drier climate expected in coming years

Water exploitation index = “moderate stress”

- 20% on index = stress
- 40% = severe stress, conditions not sustainable
- 34% = Spain’s index reading

Severe stress in some regions:

- Andalusia – 164% withdrawals over replenish rate
- Segura – 127% withdrawals over replenish rate
- Declining groundwater levels in southern Guadiana Basin
- Saltwater intrusion = poorer quality aquifer water in some coastal areas

Net result: Additional strain on remaining resources, or find alternatives

## Alternatives

	THEORETICALLY POSSIBLE?	POLITICAL OR FINANCIALLY FEASIBLE?
Potential solutions available for Spain:		
Update/expand infrastructure	✓	✗
Water conservation strategies	✓	✗
Invest in global desalination	✓	✓

# Malfunctions

Investment in water infrastructure:

Needed to prevent water loss from leaks

- Moderate losses (~16% for Spain as a whole)
- More severe in some regions (20-25% loss in Cantabria, Extremadura and Castilla-La Mancha)

Infrastructure investment strong prior to 2008 financial crisis

Spain hard-hit by crisis, significant drop in public spending

Infrastructure investments out for next several years

# Water conservation strategies

**Goal:** Encourage sustainable use in stressed and other areas

**Tactic:** Raise prices to encourage use reductions

Current prices for some irrigators don't cover cost of transporting water to crops, let alone address amounts used

Public attitudes swing against private ownership of water infrastructure

- EU Water Framework – “not a commodity like any other”
- A “common good” or “heritage” to be protected and defended

**Conclusion:** Privatization/substantial price increases unlikely

Political backlash possible

# Desalination promise

Desalination holds promise for many countries that are or will be faced with water scarcity issues

Significant promise to supplement existing sources of fresh water in urban coastal areas

Spain home to many world leaders in desalination technology

~700 desalination plants

Daily production sufficient for 8 million people

Spanish companies = largest % of competitors in global desalination market

- Research
- Design/engineering
- Construction and plant operation
- More than 50 members of Spanish Desalination and Reutilization Association

# Canada: “...Nor any drop to sell”

Even rich have problems

## Canada is “water-rich”

Home to ~7% of world’s renewable freshwater resources

<1% of world’s population

80,000 M<sup>3</sup>/capita/year – much more than other countries not considered “water stressed”

- United Kingdom – slightly over 2,300 M<sup>3</sup>/capita/year
- United States – a bit over 9,500 M<sup>3</sup>/capita/year

## What’s the problem with “wealth on paper”?

Low water prices (among lowest in OECD) encourage over-use

Unequal distribution:

- Majority of population in south
- 60% of rivers drain to the north
- Some areas experiencing a degree of water stress as a result

# Proposals from history

North American Water and Power Alliance – most extensive transfer project proposed

- Dates from 1950s
- Use existing waterways and a series of new canals, pumps, reservoirs and other elements to redistribute water in North America
- Never gained much traction

Great Recycling and Northern Development Canal of North America

- Also dates from mid-century
- Would reroute freshwater runoff from James Bay south to Great Lakes
- Projected cost: \$100 billion (1960) – more than \$800 billion (today) to build
- \$1 billion/year to operate



# Why not to share?

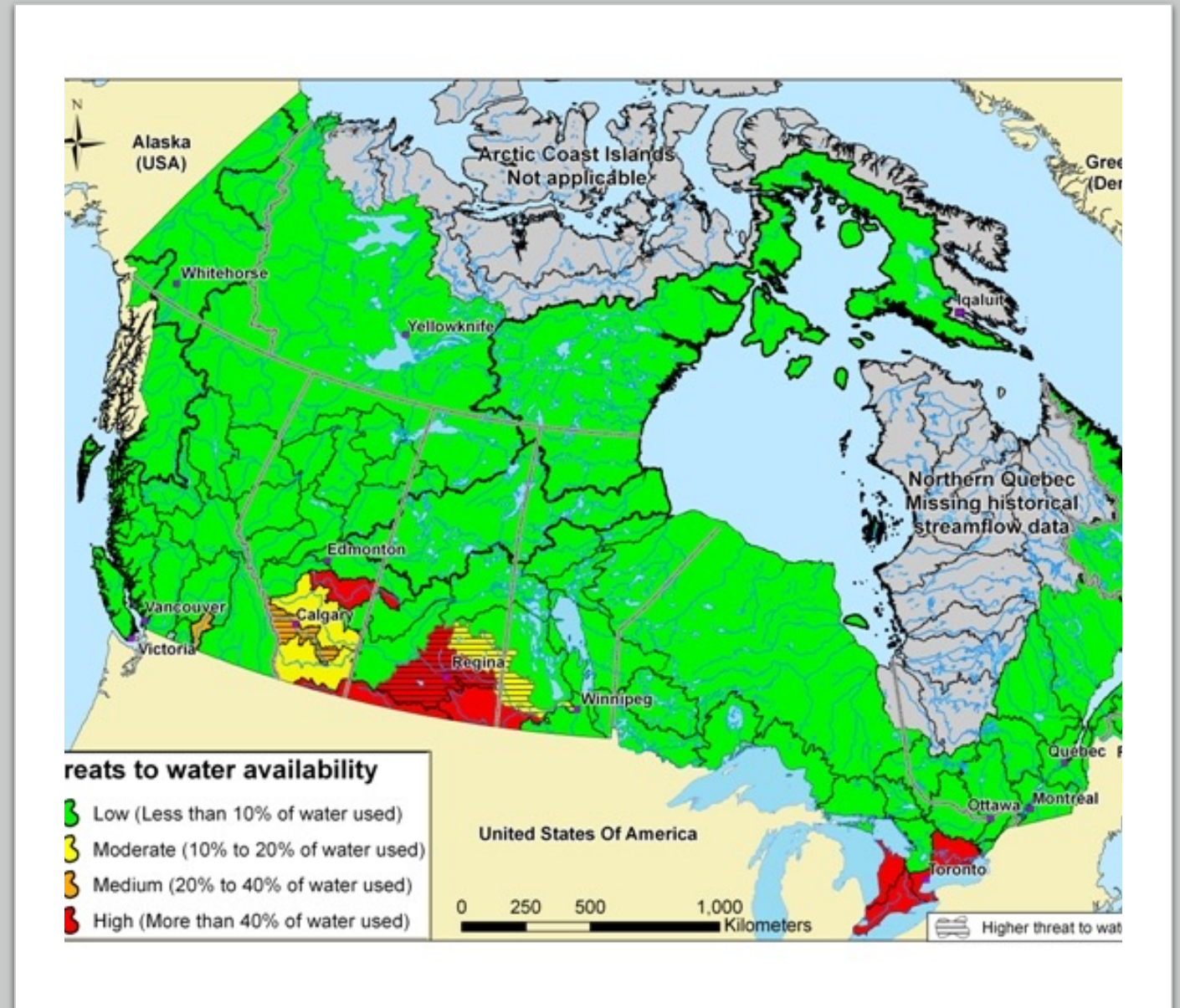
“Water export” schemes for U.S. markets have come up perennially for more than 50 years

## Technical challenges:

- Water is heavy
- Energy-intensive pumping required to move it through changing elevations
- Long-distance transfer costs can be more than 5x cost of local desalination or recycling

## Market challenges:

- Water prices don't usually reflect typical supply-demand dynamics
- Limited profit potential = limited investor potentials



# Attitudes

Political attitudes likely to prevent Canada from trading water in the same way as oil or natural gas:

- Even if economically viable

- Despite its friendship with United States

Aversion to market-based conservation techniques

- Would market pricing of Canadian water open door to legal action from NAFTA partners?

- Desire to protect water resources in era of growing scarcity

# Conclusions

- Geography will constrain access to useable freshwater resources for many countries in future
- Exports from water-rich to water-stressed regions will not follow same path as energy exports
  - Economic constraints
  - Public attitude constraints
- Water viewed as more of a right than a good
  - Even countries with water abundance will seek to protect their resources in coming years and decades

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*Thank you for your attention!*