Managing global water shortage – How effective are Water Allocation and Rights Systems ?

Guy Alaerts, Jonatan Godinez Madrigal, Andrea Mueller, Leon Hermans, Petra Hellegers, Nora Van Cauwenbergh, Joyeeta Gupta

4 November, 2023

IHE DELFT Institute for Water Education under the auspices of UNESCO
WAGENINGEN UNIVERSITY & RESEARCH
UNIVERSITEIT VAN AMSTERDAM
Ministerie van Infrastructuur en Waterstaat

A growing challenge: Relative water shortage

- Drought is more insidious and expensive than floods when it is structural
- Key issue **relative water shortage** = imbalance between supply and demand

- Incidence of relative water shortage is rising: Between 2010 and 2050 the share of world population living in river basins that are severely stressed will have risen from 16% to almost 60% ➔ The world is turning from a water-rich place to a water-short one (Sadoff et al., 2015; OECD, 2016; Van Loon and Van Lanen, 2013)

- World Bank [2016]: by 2050, water-related losses will depress GDP ≈ 6%; some regions in the world facing sustained negative growth

A growing challenge: Relative water shortage

- Drought is more insidious and expensive than floods when it is structural
- Key issue **relative water shortage** = imbalance between supply and demand

- Incidence of relative water shortage is rising: Between 2010 and 2050 the share of world population living in river basins that are severely stressed will have risen from 16% to almost 60% ➔ The world is turning from a water-rich place to a water-short one

(Sadoff et al., 2015; OECD, 2016; Van Loon and Van Lanen, 2013)

- World Bank [2016]: by 2050, water-related losses will depress GDP ≈ 6%; some regions in the world facing sustained negative growth

A growing challenge: Relative water shortage – only 30 years to be ready

- Instinctive reaction:
  - Build more reservoirs
  - Government will allocate ("who will get water, when")

- Better: Institutional arrangements to allocate water

- Complement with infrastructural measures
  - Reservoir capacity (dams, IJssel Lake, aquifers, rain harvesting …)
  - Conveyance to move water
  - Water use efficiency and reuse
  - Metering
  - Forecasting capability

A growing challenge: Relative water shortage – only 30 years to be ready

- Instinctive reaction:
  - Build more reservoirs
  - Government will allocate ("who will get water, when")

- Better: Institutional arrangements to allocate water

- Complement with infrastructural measures
  - Reservoir capacity (dams, IJssel Lake, aquifers, rain harvesting …)
  - Conveyance to move water
  - Water use efficiency and reuse
  - Metering
  - Forecasting capability

A growing challenge: Relative water shortage – only 30 years to be ready

Institutional arrangements: criteria for effectiveness

- Robust and

Able to balance

- Economic development vs Environmental sustainability
- Security of access to water vs Adaptability to change in climate and demand
- Supply-side measures vs Demand-management measures

A growing challenge: Relative water shortage – only 30 years to be ready

Institutional arrangements: typical instruments

- Administrative decision
- Rights – entitlement, concession, permit, licence …
  - Permanent (private right)
  - Temporary
  - Conditional
  - Enforcement
- Economic: tariff, trade / market of allocations, subsidy …
- Priority order
- Redress and dispute: court of law, arbitration, water tribunal …

What can we learn from country experiences ?

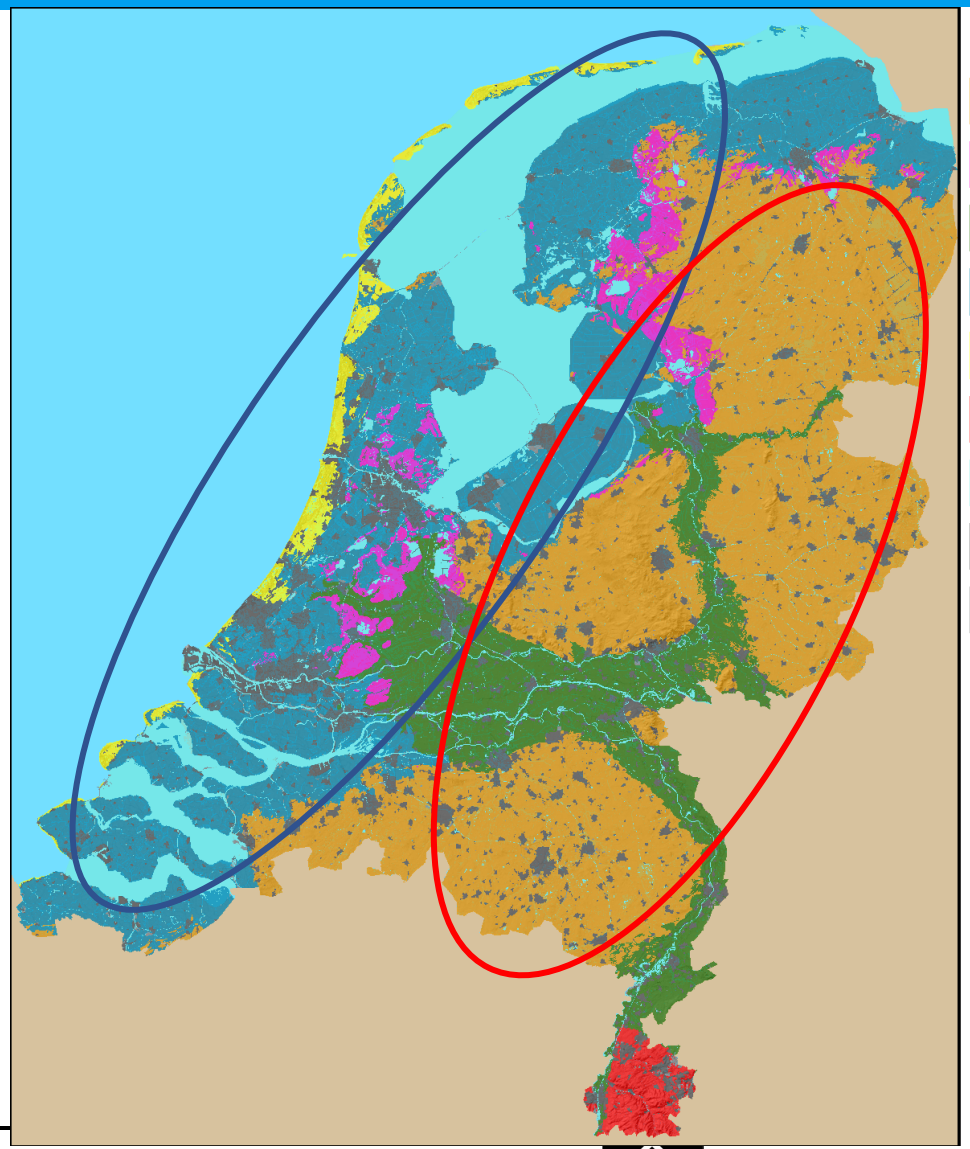
- Global assessment of formal legal and regulatory frames
- Nine in-depth analyses of representative countries to analyse actual practices

Case The Netherlands – High local specificity in water shortage and remedies

West: Peat, deltaic
Freshwater from rivers
High urban use
> Adduct water from rivers
> Polder level maintenance
> Shallow water table maint.
> Combating saline intrusion and upwelling

East/ South:
Higher sand soils
after 50 yrs of max drainage
High urban & ag use
No easy access to rivers
> Recharge groundwater
> Reduce drainage
> Control withdrawals

Open access, no permits, no trade
Water is free



Fysisch-Geografische Regios

- Hz Hogere zandgronden
- Lv Laagveengebieden
- Ri Rivierengebied
- Zk Zeekleigebied
- Du Duin- en kustzandgebied
- Hl Heuvelland
- W Water
- Be Bebouwing
- NB Niet beoordeeld

IHE DELFT Institute for Water Education under the auspices of UNESCO

WAGENINGEN UNIVERSITY & RESEARCH

UNIVERSITEIT VAN AMSTERDAM

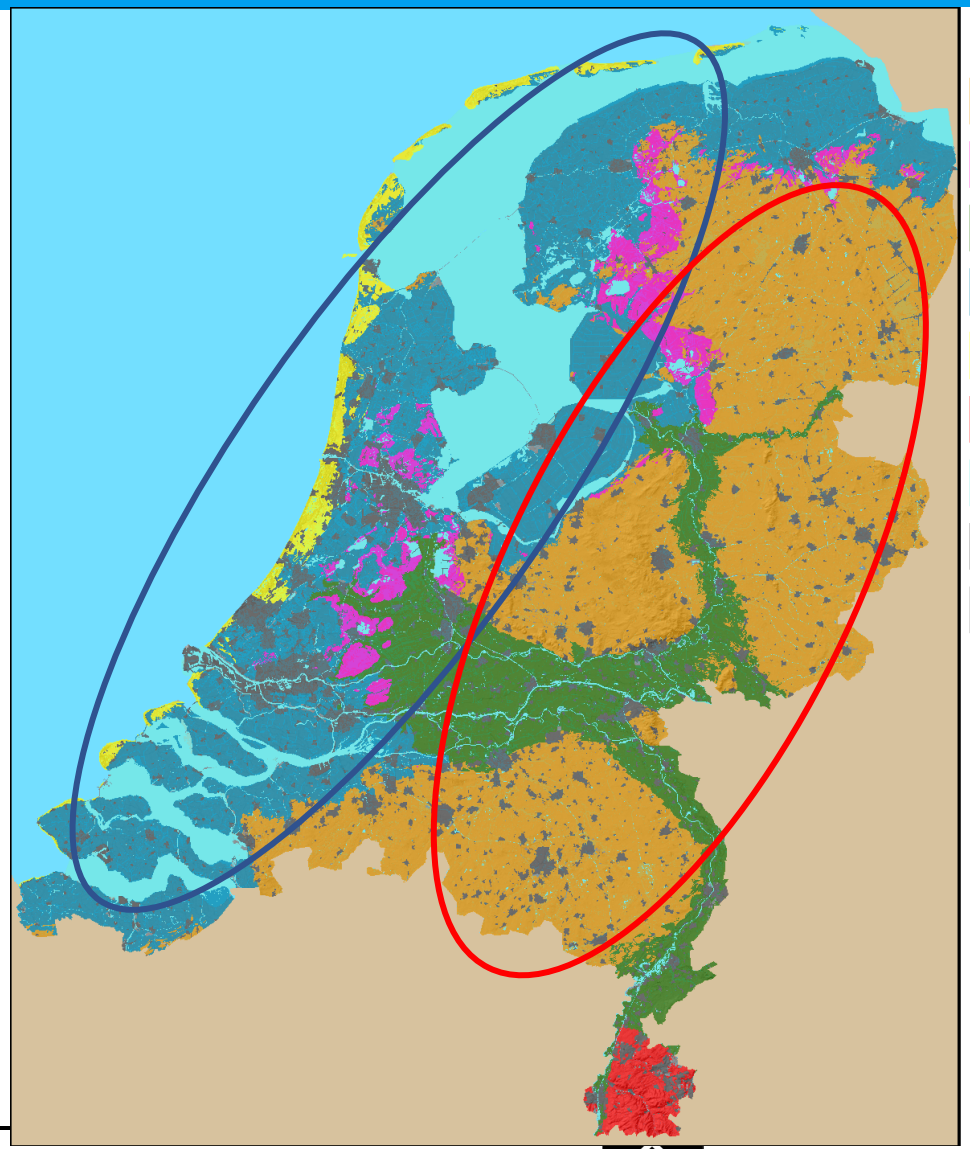
Ministerie van Infrastructuur en Waterstaat

Case The Netherlands – High local specificity in water shortage and remedies

West: Peat, deltaic
Freshwater from rivers
High urban use
> Adduct water from rivers
> Polder level maintenance
> Shallow water table maint.
> Combating saline intrusion and upwelling

East/ South:
Higher sand soils
after 50 yrs of max drainage
High urban & ag use
No easy access to rivers
> Recharge groundwater
> Reduce drainage
> Control withdrawals

Open access, no permits, no trade
Water is free



Fysisch-Geografische Regios

- Hz Hogere zandgronden
- Lv Laagveengebieden
- Ri Rivierengebied
- Zk Zeekleigebied
- Du Duin- en kustzandgebied
- Hl Heuvelland
- W Water
- Be Bebouwing
- NB Niet beoordeeld

IHE DELFT Institute for Water Education under the auspices of UNESCO

WAGENINGEN UNIVERSITY & RESEARCH

UNIVERSITEIT VAN AMSTERDAM

Ministerie van Infrastructuur en Waterstaat

Case Spain:
Confederacion Hidrografica del Jucar – **“nested” institutions**

Surface	45,000 km2
Population	5.2 million + tourists
Irrigated surf.	390,000 ha

* Acequia Real del Jucar (with 20 Juntas)
* Las Aigues de la Vega de Valencia (with 12 Juntas)
* Junta Central de Usuarios de Vilalopó (with 15 Juntas)

* “**Concession**” for water + actual **allocation**
* Trade allowed under conditions

Case Spain:
Confederacion Hidrografica del Jucar – **“nested” institutions**

Surface	45,000 km2
Population	5.2 million + tourists
Irrigated surf.	390,000 ha

* Acequia Real del Jucar (with 20 Juntas)
* Las Aigues de la Vega de Valencia (with 12 Juntas)
* Junta Central de Usuarios de Vilalopó (with 15 Juntas)

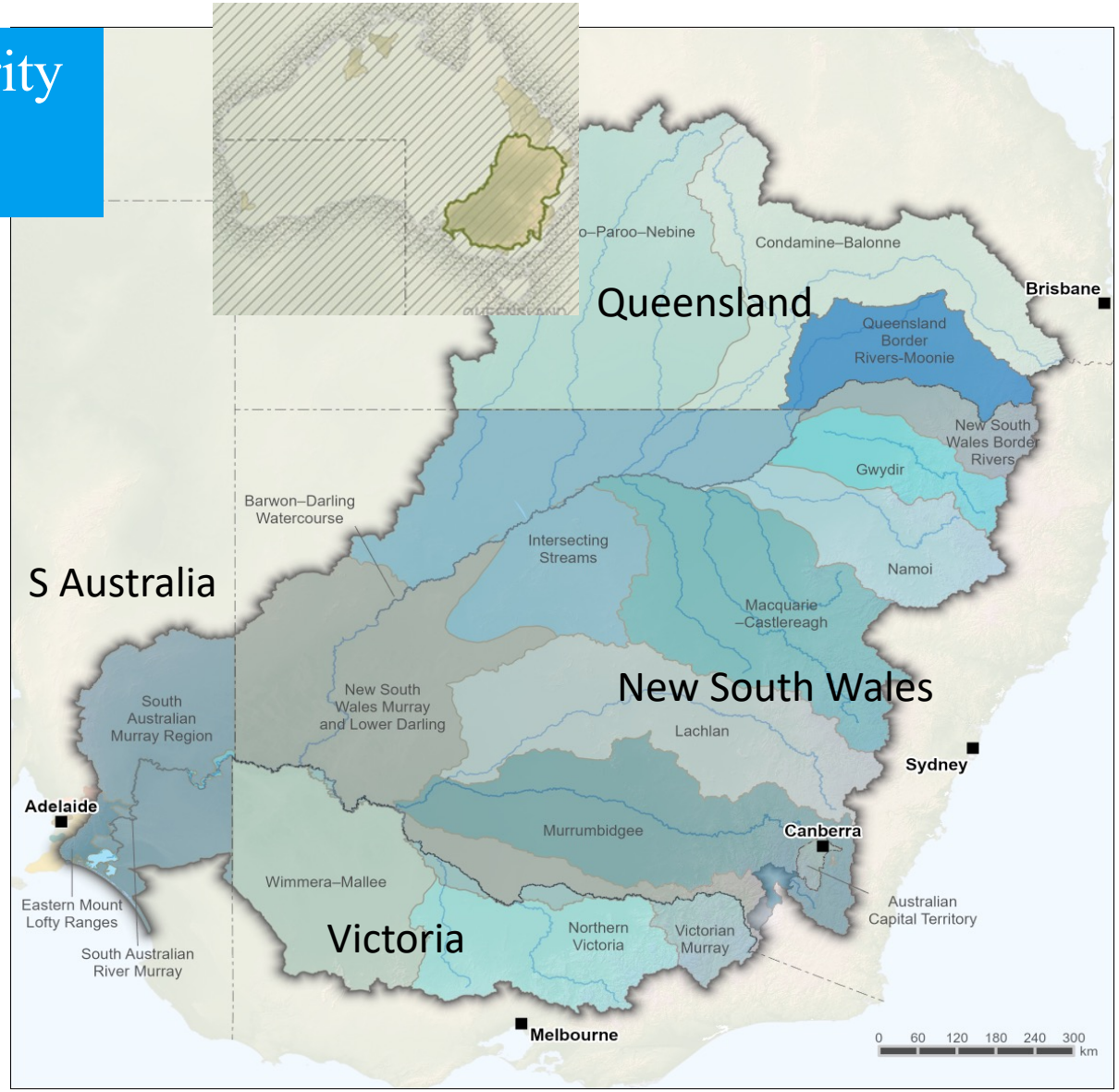
* “**Concession**” for water + actual **allocation**
* Trade allowed under conditions

Case Australia: Murray-Darling Basin Authority – Staggered allocation

Surface = France + Spain
Population 2.3 million, most large farmers
Irrigated surf. up to 30,000,000 ha

Entitlement (private & public) + actual **allocation** & **trade**

* between 4 States
* then environmental reserve (➔ "sustainable diversion limits")
* then between 28 surface water areas and 80 groundwater areas
* then between Irrigator Operators and large users
* then between individual farms and users

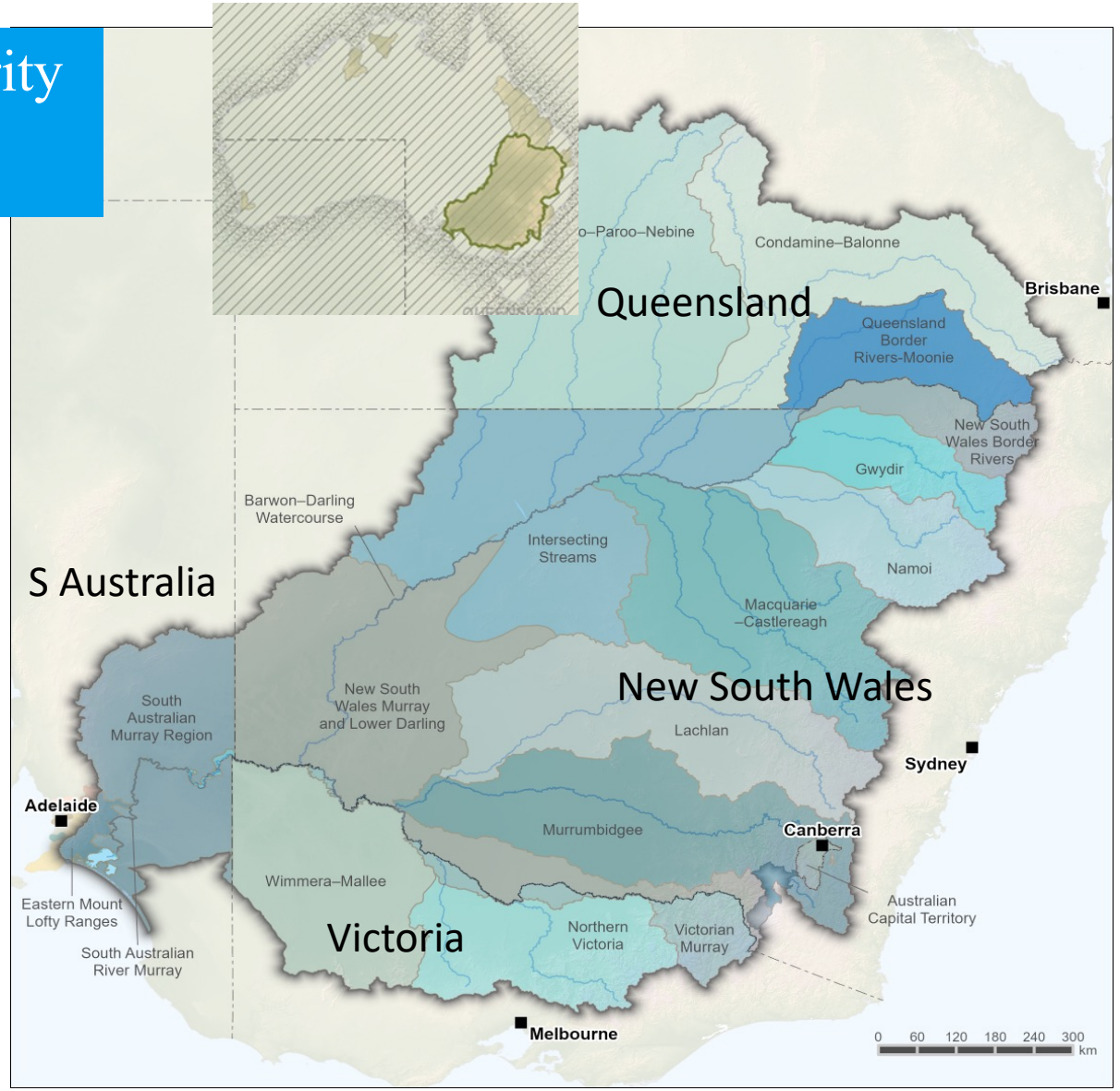


Case Australia: Murray-Darling Basin Authority – Staggered allocation

Surface = France + Spain
Population 2.3 million, most large farmers
Irrigated surf. up to 30,000,000 ha

Entitlement (private & public) + actual **allocation** & **trade**

* between 4 States
* then environmental reserve (➔ "sustainable diversion limits")
* then between 28 surface water areas and 80 groundwater areas
* then between Irrigator Operators and large users
* then between individual farms and users



Case Indonesia: Brantas river and PJT I – "Parallel realities"

Surface 11,000 km2
Population 30 million, many small farmers
Irrigated surf. ≈ 500,000 ha

* Basin Developmt Dept prepares alloc. plan
* PJT I (operator) collects fees, operates gates
* Users must have permit & pay fee
* Irrigators (WUAs): right to free water
* Trade prohibited

BUT:

* Little metering; users must self-report withdrawal; many withdrawals without permits
* In effect: only overall control (free irrigation water cannot be ensured !!)
* In effect: local Irrigator Communities and Irrigation Commission negotiate and allocate
* In effect: some bribery and circumvention
* In effect: Permit fee only to recover O&M cost

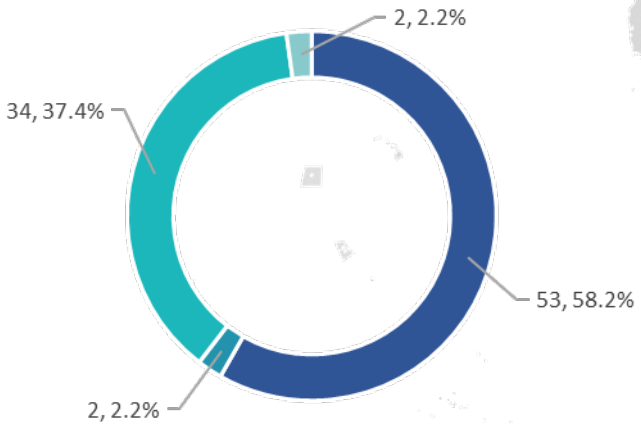
Main institutional instruments being applied

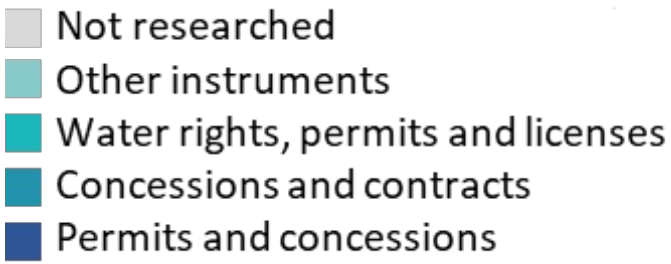
- Legal and regulatory frames (national level)
  - Universal but very diverse; how effective?
- Water administration institutions with (some) allocation responsibilities
  - Most countries; in Netherlands, Spain … very strong
- "Rights", concessions, use permits, entitlements …
  - In many countries (not: Netherlands) but in lower-income and low-governance countries full implementation is unrealistic
  - In richer countries: important tool to enhance access-security
- Economic instruments
  - Pricing: too low to influence withdrawals
  - Trading: increases both flexibility and security, allows compensation
- Collaborative platforms (irrigators, stakeholders …)
  - Consensus building
  - Local negotiation
  - Peer control of compliance
  - ➔ Powerful at local levels; strong in Netherlands ("poldering")

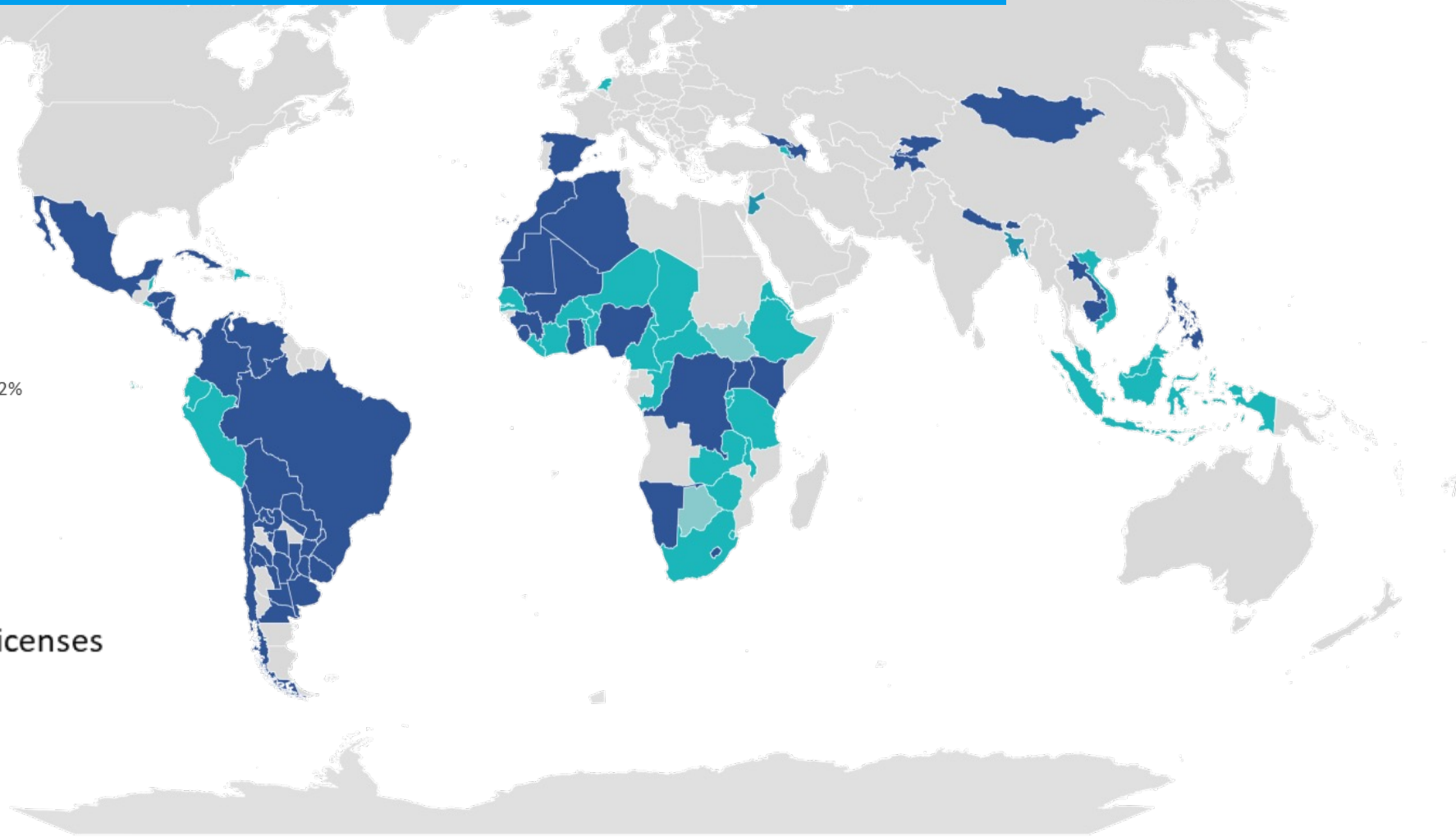
Main institutional instruments being applied

- Legal and regulatory frames (national level)
  - Universal but very diverse; how effective?
- Water administration institutions with (some) allocation responsibilities
  - Most countries; in Netherlands, Spain … very strong
- "Rights", concessions, use permits, entitlements …
  - In many countries (not: Netherlands) but in lower-income and low-governance countries full implementation is unrealistic
  - In richer countries: important tool to enhance access-security
- Economic instruments
  - Pricing: too low to influence withdrawals
  - Trading: increases both flexibility and security, allows compensation
- Collaborative platforms (irrigators, stakeholders …)
  - Consensus building
  - Local negotiation
  - Peer control of compliance
  - ➔ Powerful at local levels; strong in Netherlands ("poldering")

Instruments: Most countries provide for concessions, permits, rights …







Main institutional instruments – Risks

- Bribery and rent-seeking in issuing permits
- Excessive ambition – managing allocations is expensive in administration ➔ burnout
- Parallel realities
  - The official arrangements are overrun by local informal or traditional arrangements and deals
- Rebound (Jevons paradox)
  - Savings in water use cause *expansion* of use
- Circumvention of rules (who will enforce?)
- Hoarding – to hedge against uncertainty
- Monopolization – to speculate … causing inequity

Main institutional instruments – Risks

- Bribery and rent-seeking in issuing permits
- Excessive ambition – managing allocations is expensive in administration ➔ burnout
- Parallel realities
  - The official arrangements are overrun by local informal or traditional arrangements and deals
- Rebound (Jevons paradox)
  - Savings by a water user cause *expansion* of use
- Circumvention of rules (who will enforce?)
- Monopolization and hoarding – to hedge against uncertainty and to speculate … causing inequity

Main challenges – All countries are in transition

- Rich countries (GDP > 30,000 US$):
  - Increase sustainability: Restore / maintain ecology, over-exploited aquifers
  - Maintain security of user: Better forecasting, clear rules incl. use licences, capacitated water institutions, flexibility through negotiation among users & trade
  - “Create” freshwater: re-use, demand management, change in agronomy, desalination
- Developing and middle-income countries:
  - Gradually expand metering & monitoring
  - Improve security of user: Better forecasting, clear rules incl. use licences, flexibility through negotiation among users
  - Improve governance to address bribery and “parallel realities”
  - Work through water user platforms for collaboration and peer control
  - Promote re-use, demand management, change in agronomy …

Main challenges – All countries are in transition

- Rich countries (GDP > 30,000 US$):
  - Increase sustainability: Restore / maintain ecology, over-exploited aquifers
  - Maintain security of user: Better forecasting, clear rules incl. use licences, capacitated water institutions, flexibility through negotiation among users & trade
  - "Create" freshwater: re-use, demand management, change in agronomy, desalination
- Developing and middle-income countries:
  - Gradually expand metering & monitoring
  - Improve security of user: Better forecasting, clear rules incl. use licences, flexibility through negotiation among users
  - Improve governance to address bribery and "parallel realities"
  - Work through water user platforms for collaboration and peer control
  - Promote re-use, demand management, change in agronomy …

Main challenges – All countries are in transition

- Rich countries (GDP > 30,000 US$):
  - Increase sustainability: Restore / maintain ecology, over-exploited aquifers
  - Maintain security of user: Better forecasting, clear rules incl. use licences, capacitated water institutions, flexibility through negotiation among users & trade
  - "Create" freshwater: re-use, demand management, change in agronomy, desalination
- Developing and middle-income countries:
  - Gradually expand metering & monitoring
  - Improve security of user: Better forecasting, clear rules incl. use licences, flexibility through negotiation among users
  - Improve governance to address bribery and "parallel realities"
  - Work through water user platforms for collaboration and peer control
  - Promote re-use, demand management, change in agronomy …

Instruments: Tariffs for water withdrawal, and Trade prices

COUNTRY / BASIN	Water Stress Index	Tariff (US¢ / m3)	Trade Price and Volume (US¢ / m3)
Jucar basin (Spain) (2015) (public domain with concessions)	88%	5 – 100	20 – 30 (*average*) 1 % of water use
Murray-Darling Basin (Australia) (2019) (private entitlements + public)	60%	20 - 50	7 (*temp.*) – 80 (*perm.*) 7,000 million m3 ≈ 1 billion US$
China 29 pilots for trading	50-90%	0.5 - 10	2 – 5 (*irrig*) – 15 (*industry*) 1,250 million m3
Brantas basin (Indonesia) (2022) (tariff only)	110%	0 (*irrig*) – 1 (*water supp*) – 2 (*industry*)	Only informal within Irrig Association
Netherlands	17%	0 2 (deep grw.)	Only informal & in re-use schemes

Increasing sustainability: Water buybacks, Water Banks, and demand management

	Buyback Volume m3	Buyback Budget US$
Spain (2005-2010)	11,000	≈ 90 million
Murray-Darling Basin (Australia) (2005-2027)	2,100 million (≈ 25% of total use)	≈ 4 billion
China pilots	0	0
Netherlands	By admin decision	Cost ?

Increase envir. flow
Recharge aquifers

The Netherlands:

- Main program to bring riverwater to western provinces (protect peat, maintain polder level and ecosystems, combat salinization)
- Sandy soils: re-arrange land and let rivers meander to drain less and absorb more rainwater

Increasing sustainability: Case Spain – Acequia Real del Jucar – Cap-and-trade works

Sustainability = environmental flow (esp. Albufera lagoon [Ramsar site])
recharge of aquifers

Allocation	1985	70,000 m3	to irrigation	
	2000	39,200 m3	to irrigation	
	2020	20,000 m3	to irrigation +	2,000 m3 to environment

Through irrigation efficiency, reduced loss,
allocation cap, pricing, subsidies

Two important observations regarding water users

- The main worry of water users is lack of predictability and fear of losing out. All behaviour then turns defensive and “political”, thus complicated.

  Developing (in Spain) a suite of regulations and institutions (concessions, trading, pricing, forecasting, scenarios on what-to-do-if, etc.) has created clarity on 90% of all potential issues. The remaining 10% of decisions then can be addressed at political level.

- Most water users accept reduction of their entitlement or re-allocation by *administrative decision*. But they prefer *trades* because this provides fair compensation for the reduction.

Tentative conclusions and trends

- All countries will remain in transition for decades to come
- Effective institutions must be coherent and “fit” within country system
- Formalisation of individual withdrawals / uses may be inevitable
- Effective allocation and rights systems =

  comprehensive metering (expensive) plus *strong governance*
- Effective allocation is very locality-specific
- Economic instruments – pricing, trading – are helpful but not sufficient
- Collaborative arrangements of users will remain very important
- There are no “best practices” only “good principles and instruments”

Tentative conclusions and trends

- All countries will remain in transition for decades to come
- Effective institutions must be coherent and “fit” within country system
- Formalisation of individual withdrawals / uses may be inevitable
- Effective allocation and rights systems =

  comprehensive metering (expensive) plus *strong governance*
- Effective allocation is very locality-specific
- Economic instruments – pricing, trading – are helpful but not sufficient
- Collaborative arrangements of users will remain very important
- There are no “best practices” only “good principles and instruments”

Tentative conclusions and trends

- All countries will remain in transition for decades to come
- Effective institutions must be coherent and “fit” within country system
- Formalisation of individual withdrawals / uses may be inevitable
- Effective allocation and rights systems =

  comprehensive metering (expensive) plus *strong governance*
- Effective allocation is very locality-specific
- Economic instruments – pricing, trading – are helpful but not sufficient
- Collaborative arrangements of users will remain very important
- There are no “best practices” only “good principles and instruments”

Tentative conclusions and trends

- All countries will remain in transition for decades to come
- Effective institutions must be coherent and “fit” within country system
- Formalisation of individual withdrawals / uses may be inevitable
- Effective allocation and rights systems =

  comprehensive metering (expensive) plus *strong governance*
- Effective allocation is very locality-specific
- Economic instruments – pricing, trading – are helpful but not sufficient
- Collaborative arrangements of users will remain very important
- There are no “best practices” only “good principles and instruments”

Thank you !

Institutional coherence