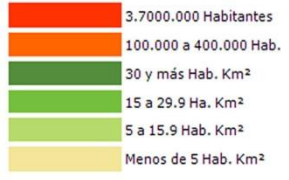


# Integrated Water Resource Management In Chile

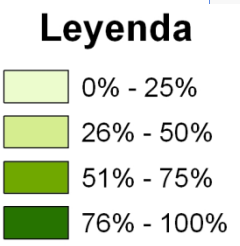
Guillermo Donoso  
Departamento de Economía Agraria



PONTIFICIA  
UNIVERSIDAD  
CATÓLICA  
DE CHILE



## POPULATION

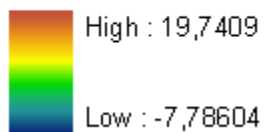


## AGRICULTURE



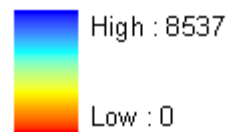
**Average  
Annual  
Temperature  
(° Celsius)**

**Leyenda**



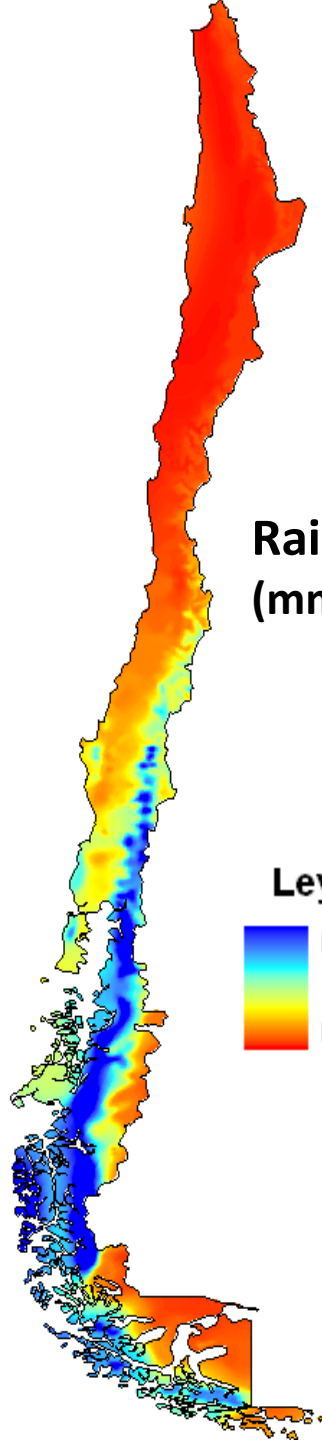
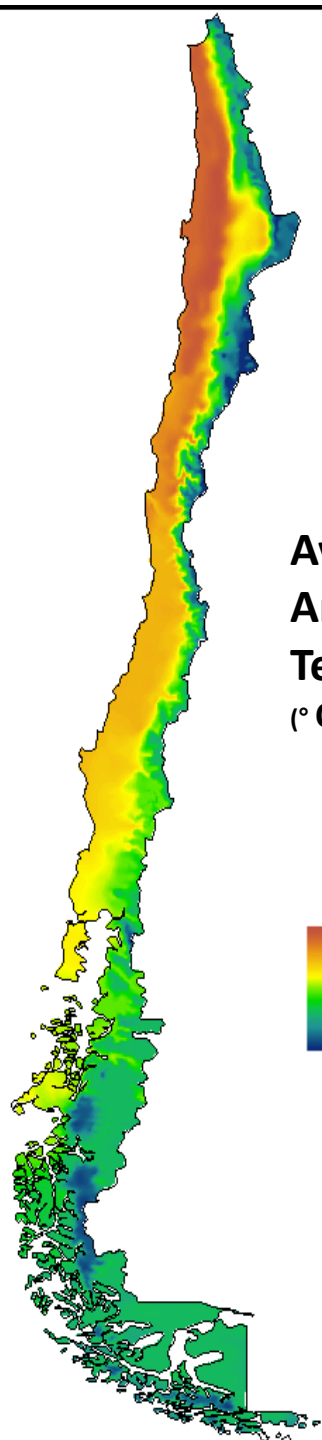
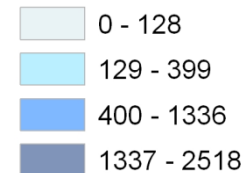
**Rainfall  
(mm/year)**

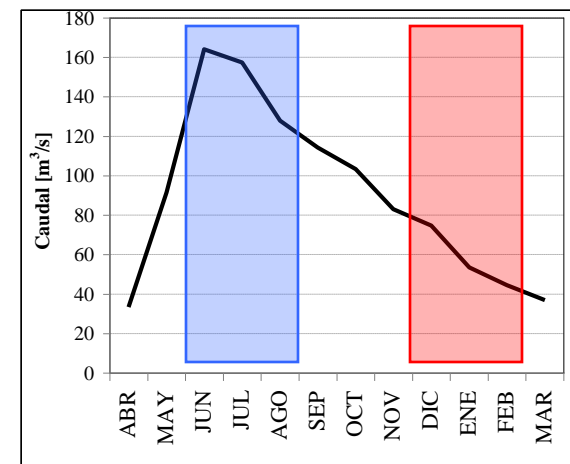
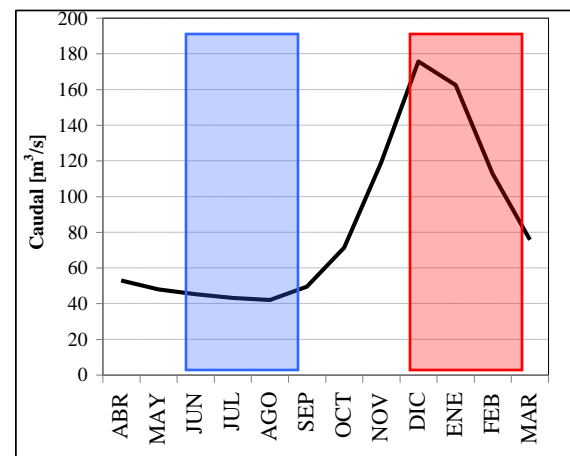
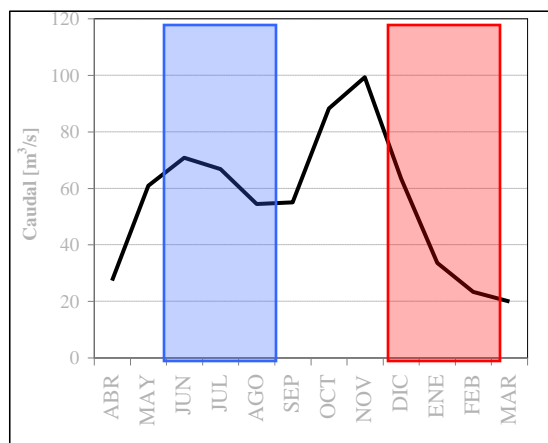
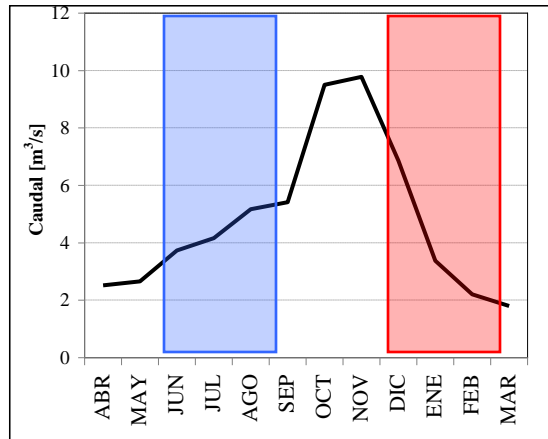
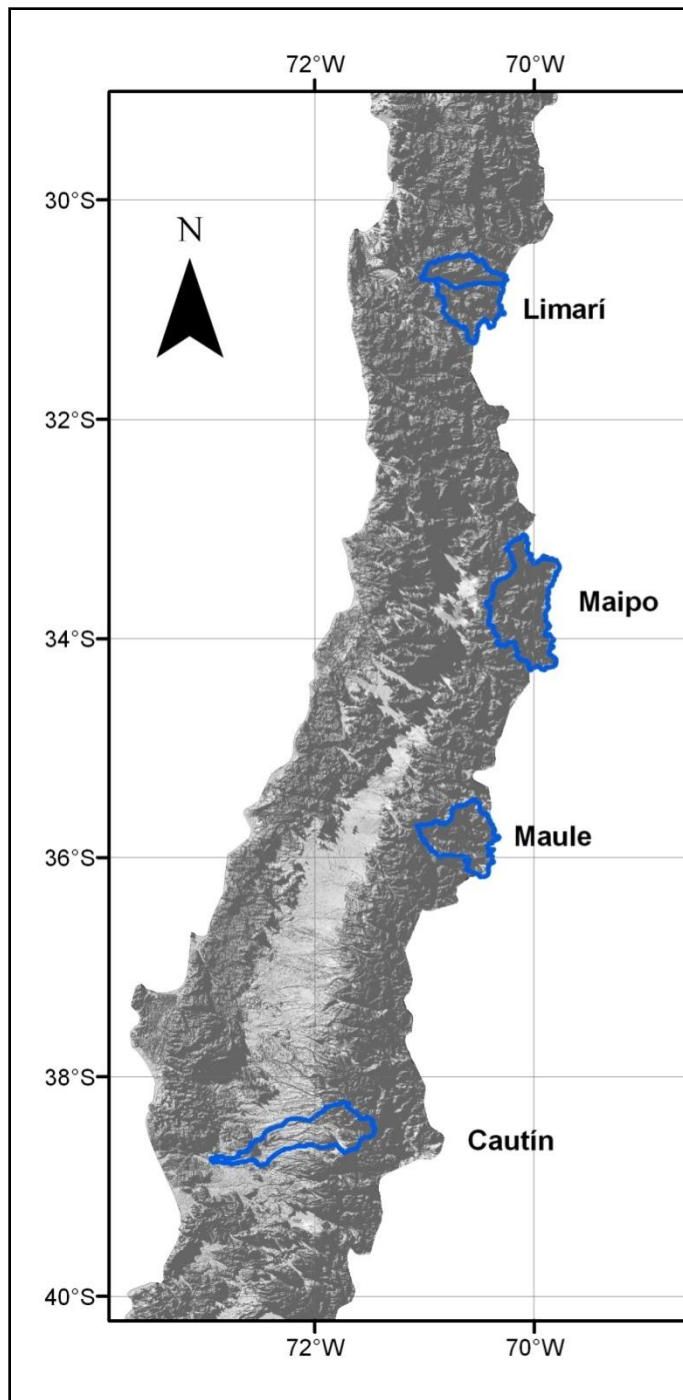
**Leyenda**



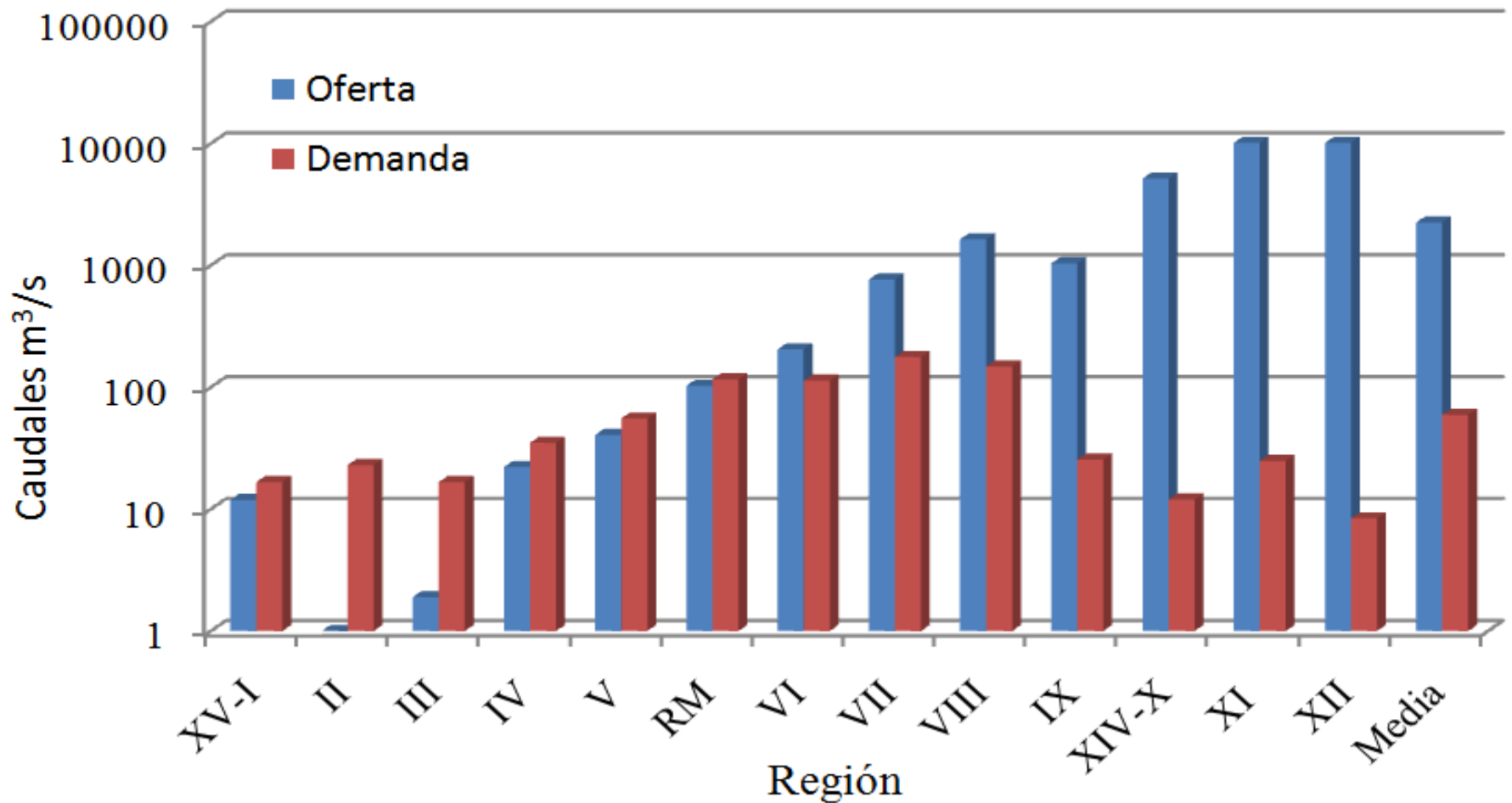
**Water Flows  
(mm/año)**

**Leyenda**





# Hydrological Droughts in Chile



# The Challenge of Water Management

## A historical challenge

*"Rival" proceeds from latin "rivalis", which means "those that share a river"*



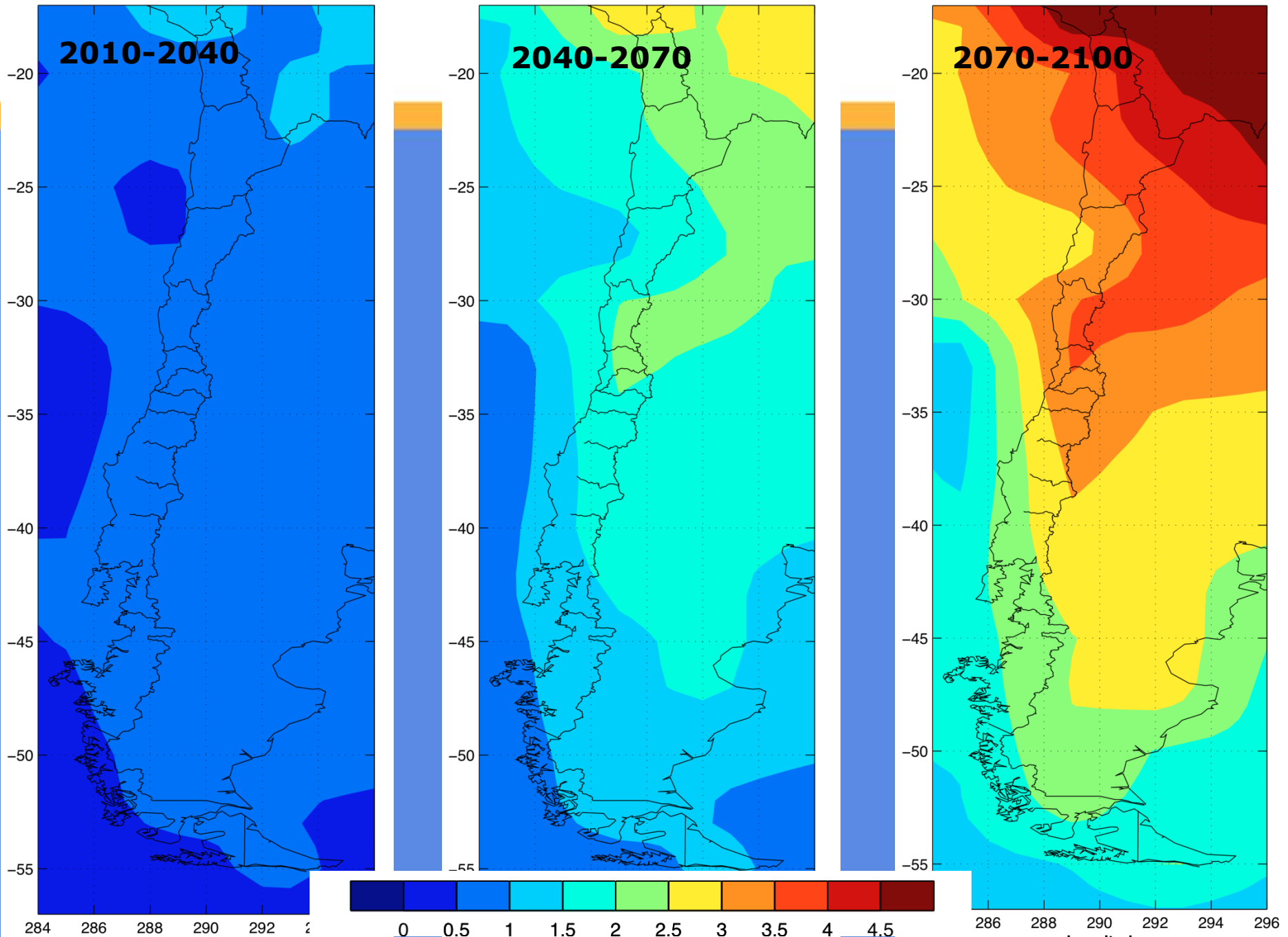
# Challenges that will increase in the Future due to Climate Change



Changes in water supply:  
magnitud and timing

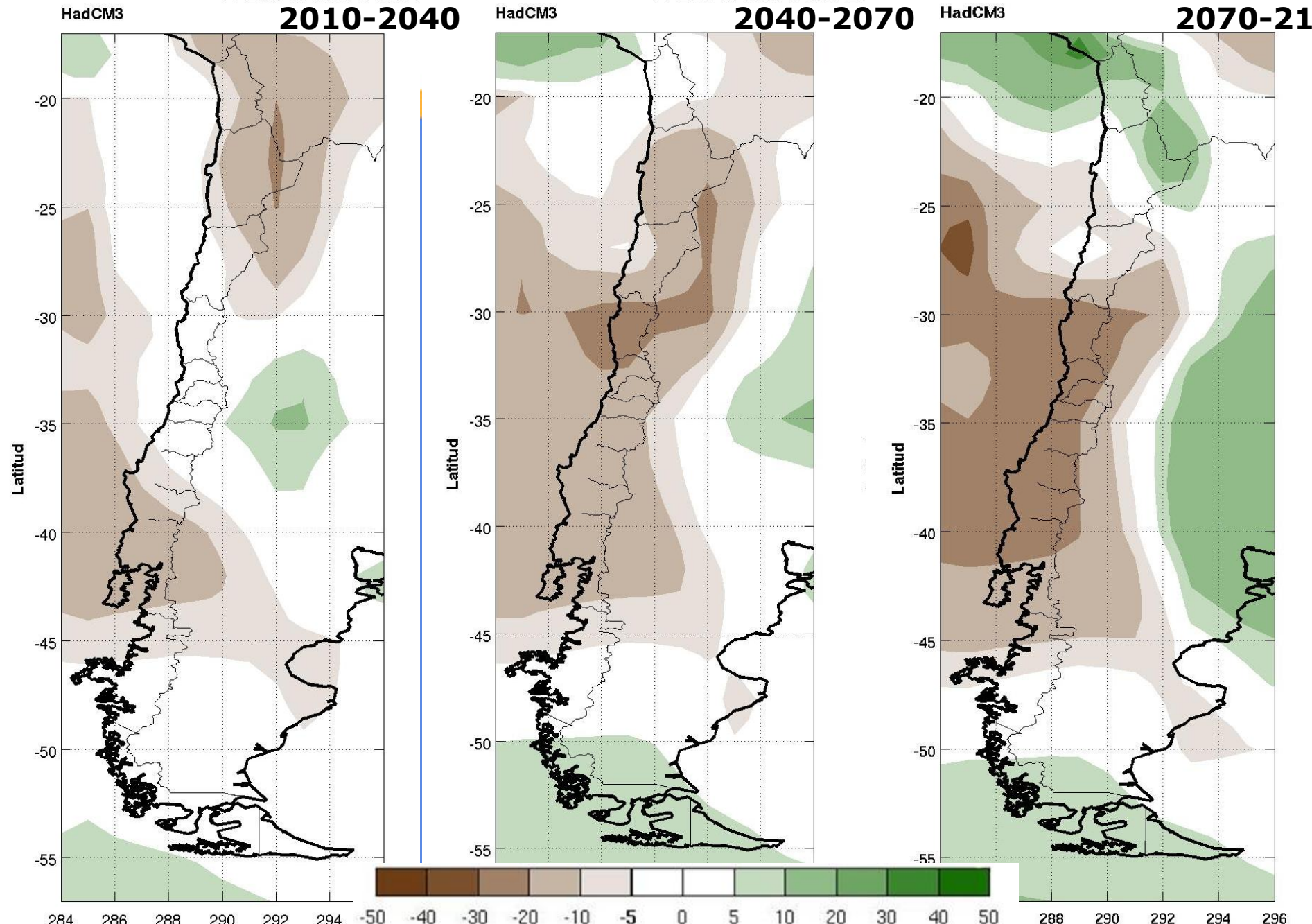
Changes in water demand

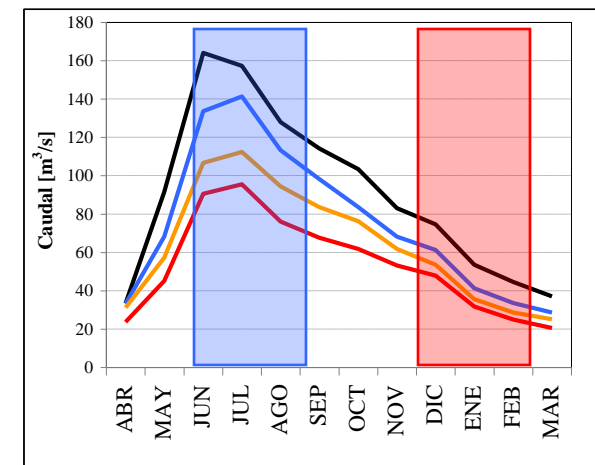
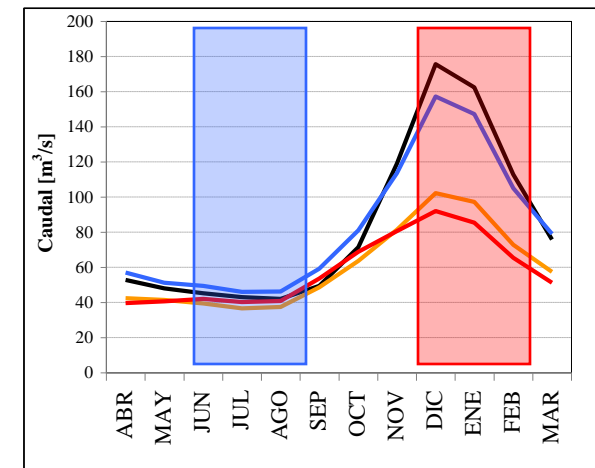
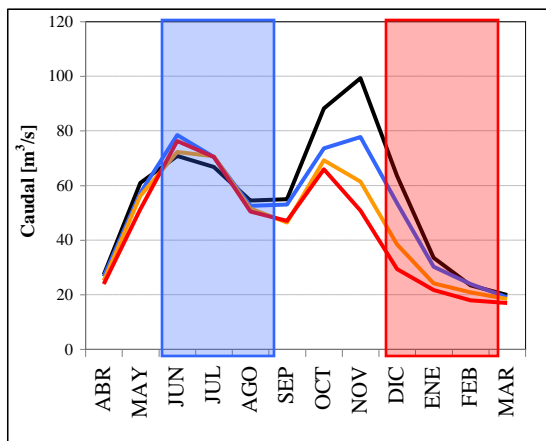
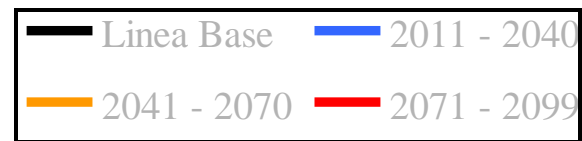
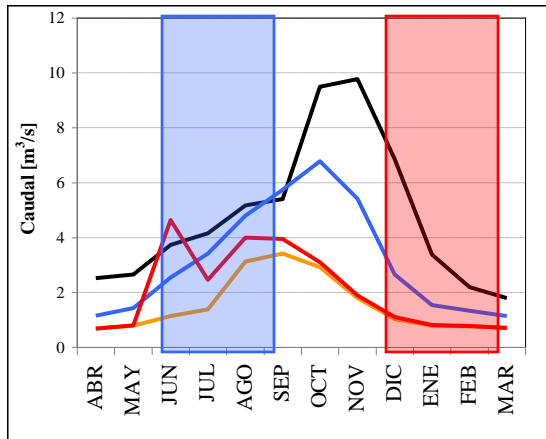
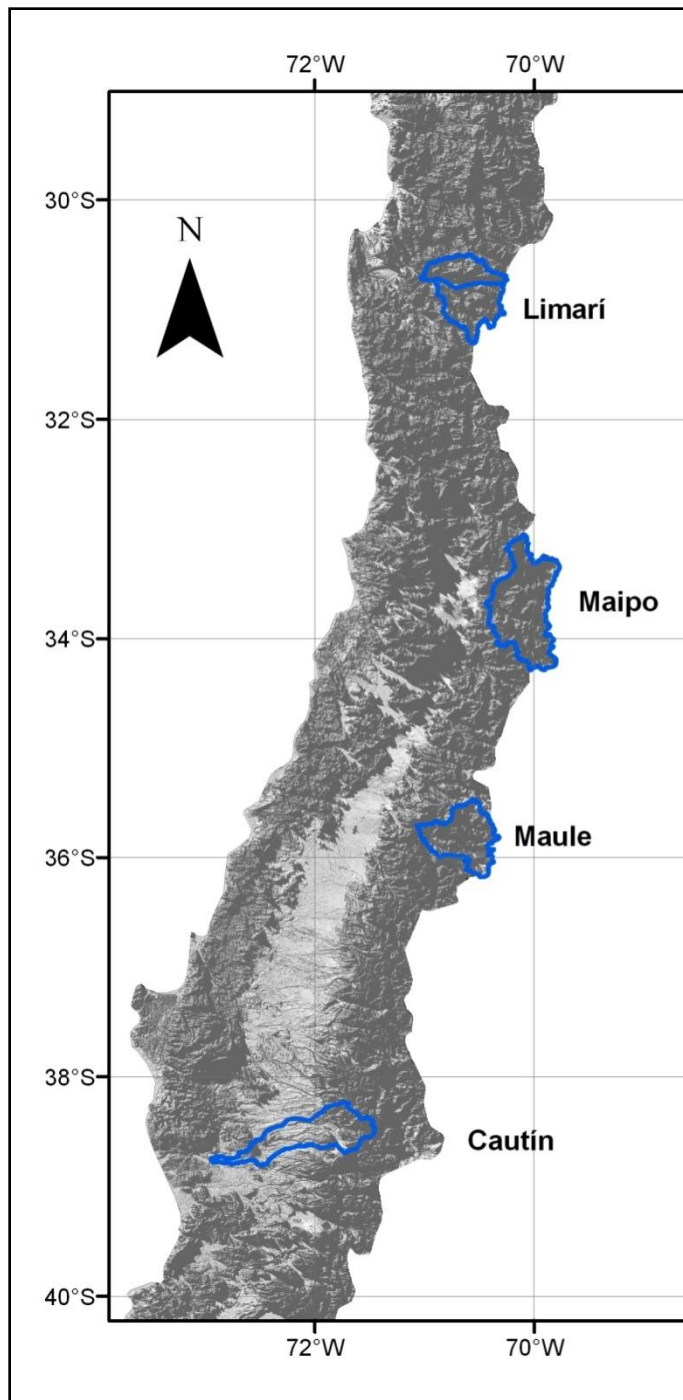
# Temperature Projections– HadCM3





# Rainfall Projections – HadCM3





# Changes in Demand

**Tabla 2.4 Crecimiento del uso del agua por sectores (m<sup>3</sup>/s/año)**

Uso	1990	1999	2002	2006
Riego	516	611	647	527*
Agua potable	27	34	37	40
Industrial	47	68	77	84
Minería	43	51	53	63
Energía	1.189	2.914	3.929	3.997
<b>Total</b>	<b>1.823</b>	<b>3.678</b>	<b>4.743</b>	<b>4.711</b>

*Fuente:* Universidad de Chile, 2010.

\*: El año 2006 fue particularmente lluvioso lo que podría explicar en parte la disminución importante de las extracciones de agua con fines agrícolas entre 2002 y 2006.

# Integrated Water Management Challenges



- **Institutionality**
- **River Sections and Aquifer  
Hidrological Sectors**

# Integrated Water Management Challenges



- **Institutionality**
  - **Under the Water Code of 1981, the State reduced its intervention in water resources management to a minimum**
  - **And increased the management powers of water use rights holders that are organized in water user associations**

# Integrated Water Management Challenges



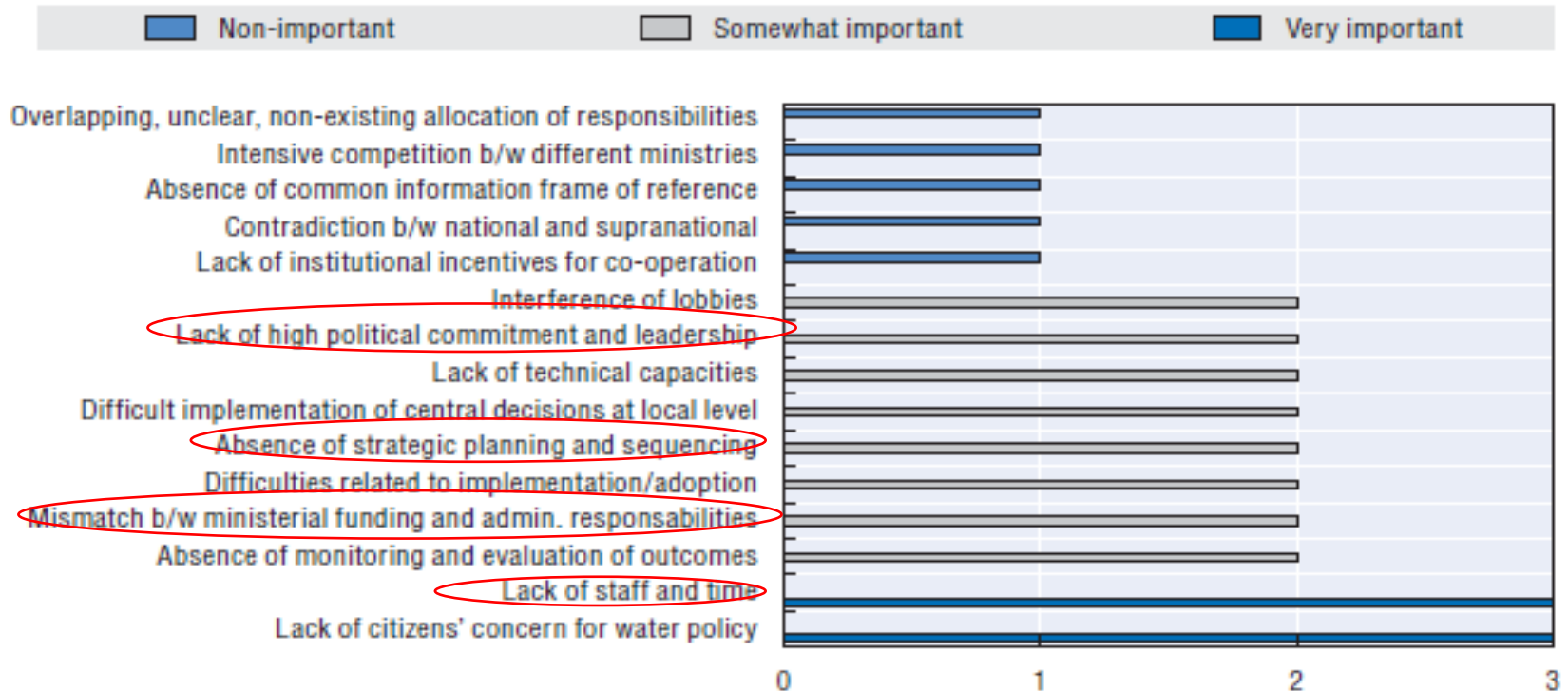
## Public Institutionalality

Roles	Areas	Water resources	Water services			
			Water supply			Wastewater treatment
			Domestic	Agriculture	Industry	
Strategy, priority setting, and planning (including infrastructure)		Ministry of Public Works (MOP) through: <ul style="list-style-type: none"> <li>• General Water Authority (DGA)</li> <li>• Directorate General for Hydraulic Works (DOH)</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Urban:</i> Superintendence of Sanitary Services (SISS)</li> <li>• <i>Rural:</i> Rural drinking water programme, DOH, Ministry of Public Works</li> </ul>	<ul style="list-style-type: none"> <li>• Ministry of Agriculture (Minagri) through the Executive Secretariat of the National Commission for Irrigation (CNR)</li> <li>• Ministry of Public Works, DOH</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Hydroelectricity:</i> National Energy Commission (CNE)</li> <li>• <i>Mining:</i> Chilean Commission of Copper, Department of Mining</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Urban:</i> SISS</li> <li>• <i>Rural:</i> MOP – A bill to institutionalise this matter is being discussed by the Parliament</li> </ul>
Policy-making and implementation		MOP, DGA	<ul style="list-style-type: none"> <li>• <i>Urban:</i> SISS</li> <li>• <i>Rural:</i> MOP-DOH</li> </ul>	<ul style="list-style-type: none"> <li>• Minagri, Executive Secretariat</li> <li>• CNR</li> <li>• MOP-DOH</li> </ul>		<ul style="list-style-type: none"> <li>• <i>Urban:</i> SISS</li> <li>• <i>Rural:</i> MOP, through DOH</li> </ul>
Information, monitoring and evaluation		DGA	<ul style="list-style-type: none"> <li>• <i>Urban:</i> SISS</li> <li>• <i>Rural:</i> PAPER-DOH</li> </ul>	<ul style="list-style-type: none"> <li>• Minagri</li> <li>• CNR</li> </ul>		<ul style="list-style-type: none"> <li>• <i>Urban:</i> SISS</li> <li>• <i>Rural:</i> Directorate General for Hydraulic Works, Ministry of Public Works</li> </ul>
Stakeholders engagement (citizens' awareness, etc.)		DGA, National Commission for the Environment, DOH, CNR	<ul style="list-style-type: none"> <li>• <i>Urban:</i> SISS</li> <li>• <i>Rural:</i> Water companies and DOH</li> </ul>	<ul style="list-style-type: none"> <li>• Minagri</li> <li>• CNR</li> <li>• MOP-DOH</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Hydroelectricity:</i> National Energy Commission (CNE)</li> <li>• <i>Mining:</i> Chilean Comm. of Copper, Dept. of Mining</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Urban:</i> SISS</li> <li>• <i>Rural:</i> Although it is scarce in rural areas, Regional Governments and Municipalities can be mentioned</li> </ul>
Other (specify)		Organisations of professionals	<ul style="list-style-type: none"> <li>• Water companies</li> </ul>	<ul style="list-style-type: none"> <li>• Associations of irrigation users</li> </ul>	<ul style="list-style-type: none"> <li>• Private Associations</li> </ul>	<ul style="list-style-type: none"> <li>• Water companies</li> </ul>

# Integrated Water Management Challenges



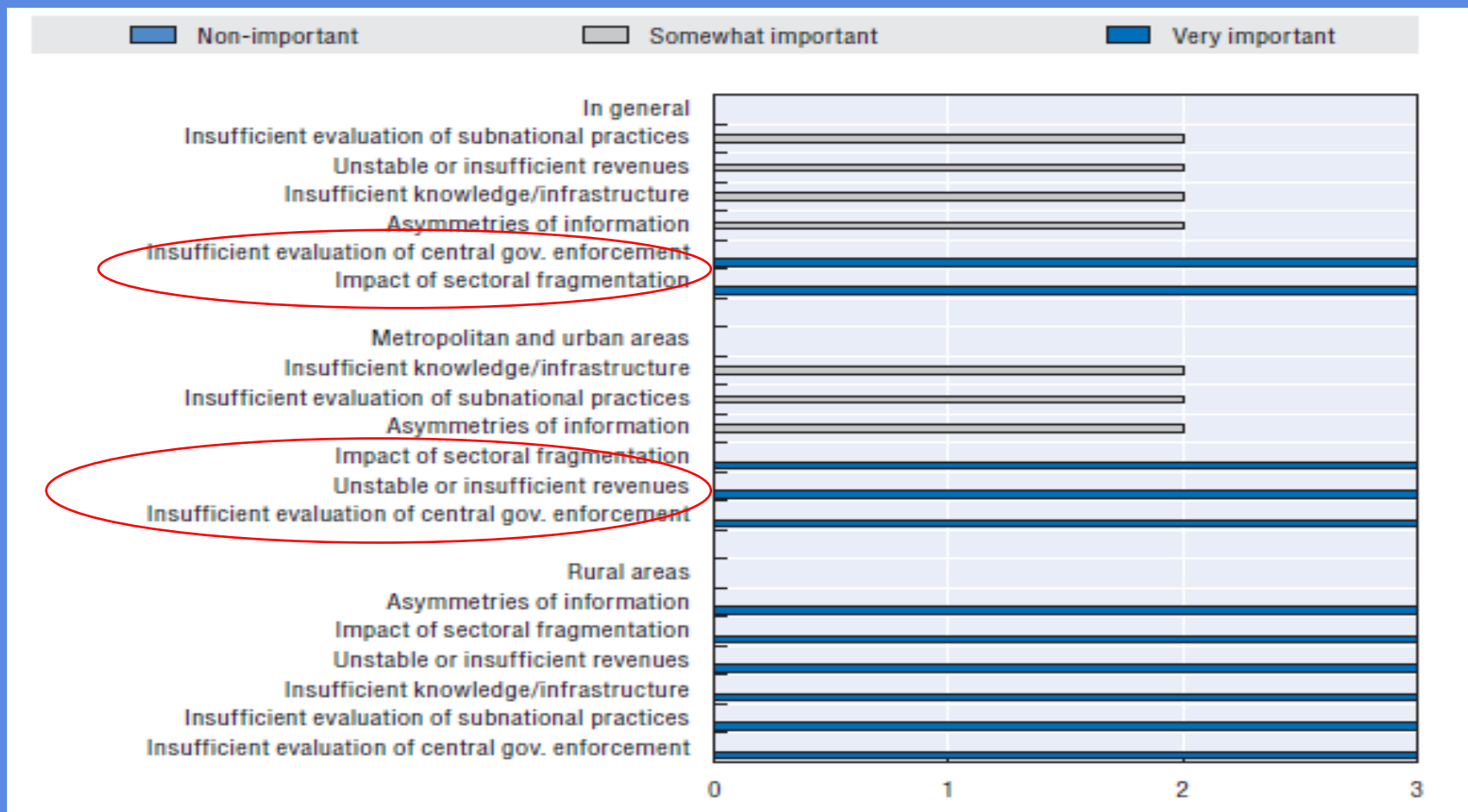
## Obstacles to Coordinate Public Agencies



# Integrated Water Management Challenges



## Obstacles to Vertical Coordination





# Integrated Water Management Challenges



## Water User Associations

CHARACTERISTIC	COMUNIDADES DE AGUAS	ASOCIACIÓN DE CANALISTAS	JUNTAS DE VIGILANCIA
Water source	Artificial water distribution infrastructure	Artificial water distribution infrastructure	Superficial Water Resources; as of 2005 Groundwater Resources
Jurisdiction	Jurisdiction on water flows that do not exceed channel capacity.	Jurisdiction on water flows that do not exceed channel capacity.	Jurisdiction on natural and artificial reservoirs and rivers at a basin or river section
Constitution Requisites	Born by the fact that two or more users draw water from the same source, river sector or hydrogeological sector and distribute it through the same infrastructure.	Result of a formal act where the Association obtains . legal status	Necessary that water users be organized.
Recognition Requisites	Identification of water use right holders, and water allocations as well as who owns the infrastructure.	Requires a document that establishes water user's will to associate themselves voluntarily. Obtains recognition by the President of the Republic.	Same as requisites for comunidad de agua, and is awarded recognition by the President of the Republic.
Functions	Maintenance of distribution infrastructure, water distribution and conflict resolution.	Maintenance of distribution infrastructure, water distribution and conflict resolution.	<p>Distribute, manage and conflict resolution</p> <p>Oppose new water use rights that may affect water users</p> <p>Analyze and oppose water use right transfers if they affect water users</p> <p>Control water quality of discharges</p> <p>Groundwater users and exploration</p> <p>Control that actions in upper basin áreas or other áreas do not affect distribution of water to water use rights holders.</p> <p>Construct and mantain water intake infrastructure.</p>

# Integrated Water Management Challenges



## Water User Associations

**The Good:** Strong Rule of Law,  
Effective Collective Management

**The Bad:** Weak Rule of Law,  
Water Management

**The Ugly:** No Rule of Law, No  
water management, just distribution



# Integrated Water Management Challenges



- River Sections and Aquifer Hydrogeological Sectors
  - Considered independent of one another.
  - DGA definition:
    - Sectors that allow for an **independent** management
    - Applies to
      - Surface Water vrs Groundwater
      - River sections
      - Hydrogeological aquifer sections

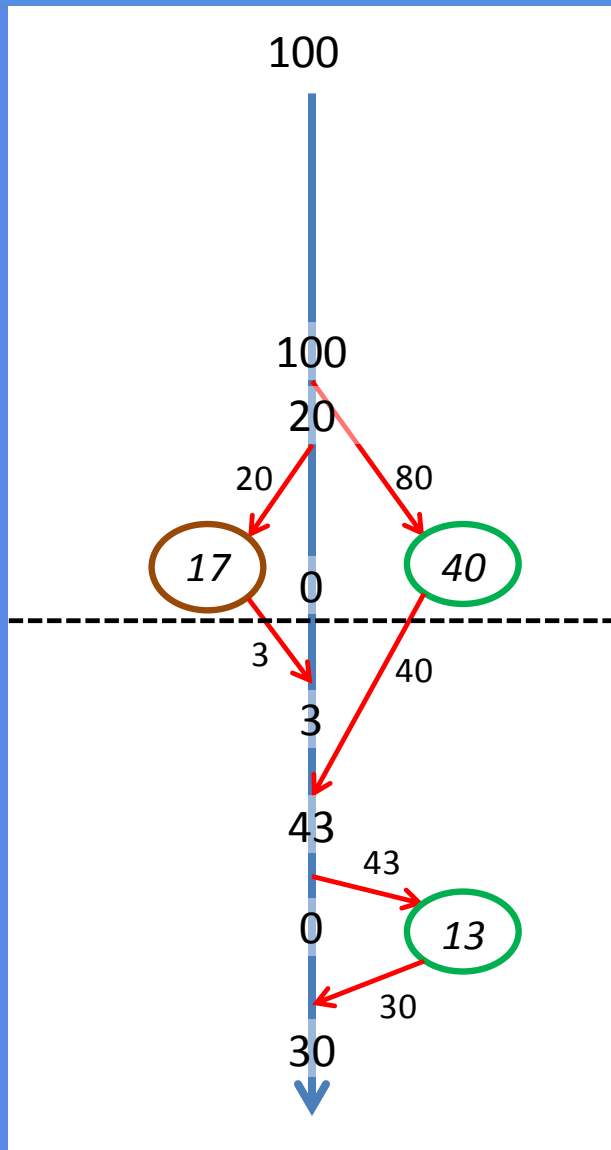
# Integrated Water Management Challenges



## Copiapó Acuífero Hydrogeological Sectors

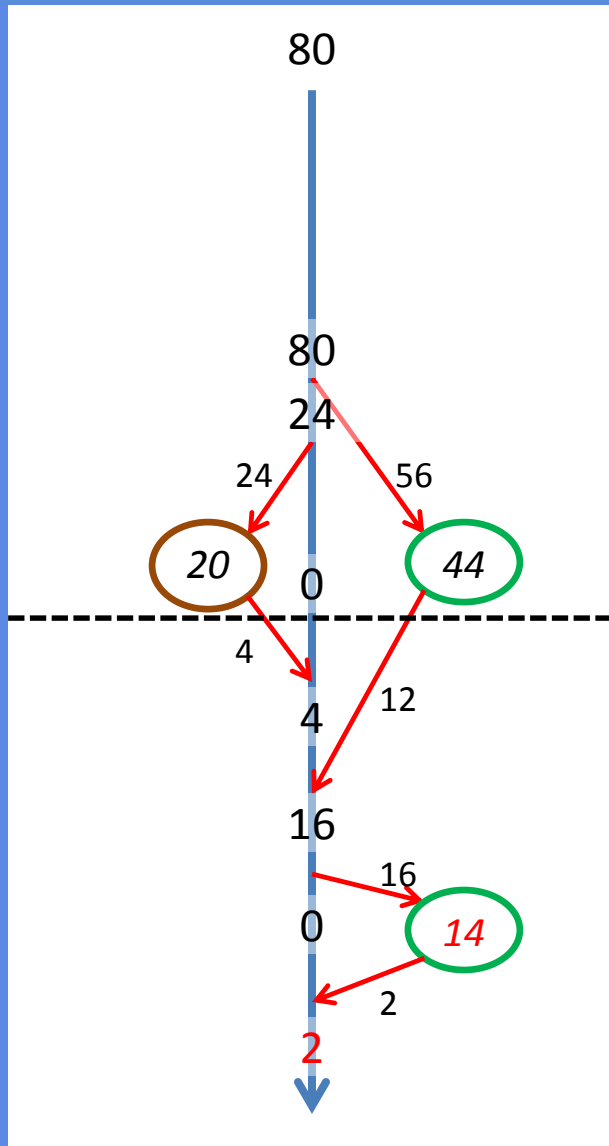
Sector	Flujo Entrante (l/s)	Recarga (l/s)	DAA Otorgados (N° Pozos)	Caudal Otorgado (l/s)	Flujo Saliente (l/s)	Balance Hídrico (l/s)
1	19	1,901	39	2.187	513	-18
2	513	173	51	3.380	66	-172
3	66	967	71	4.107	118	-151
4	118	681	77	4.115	227	-526
5	227	220	127	3.895	112	-583
6	112	144	75	1.938	0	-283

# Simplified Vision of Maipo Water Basin



- No significant water regulation capacity.
- Main water user
  - 1 section is urban and agriculture
  - 2 section is agriculture
- Agricultural efficiency 1 section = 50%
- Agricultural efficiency 2 section = 30%
- Ecological water flows lower section = 25

# Possible future scenario Maipo Water Basin



- Climate Change Effect
  - Water Flow Reduction (-20%)
  - Agricultural Demand 1 = 44 (+10%)
  - Agricultural Demand 2 = 15 (+10%)
- Urban population growth
- Increase water use efficiency:
  - 50 a 73% Irrigation 1, 30 a 85% Irrigation 2
- Market transaction of 10%
- Hydrological droughts (:
  - Ecological water flows =  $25 - 2 = 23$  (-92%)
  - Irrigation 2 =  $15 - 14 = 1$  (-9%)

# Key Actions



Increase the awareness of both the political leadership, water users and the society at large about the urgent need to move towards IWRM so as to involve stakeholders;

Implement Comunidades de Aguas Subterráneas;

Incorporate groundwater users to Juntas de Vigilancia;

Strengthen all User Associations

- Strong rule of law
- Effective Conflict Resolution
- Effective collective management

# Key Actions



Implement Supra Organizations of Juntas de Vigilancia to integrate different river sections and aquifer hydrogeological sectors;

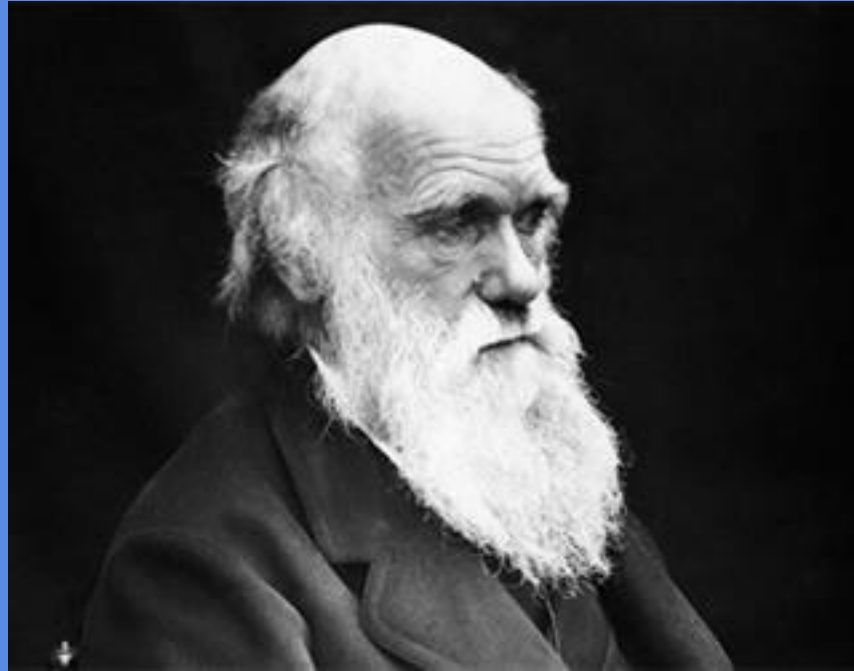
- CASEP – Valle Limarí
  - Integrates Three Juntas de Vigilancia

Implement efficient negotiation and conflict management since it will not be able to please everyone.

Work with the media to constantly inform society of the advances and short term wins so that society at large maintains its motivation towards the change process.



# Need for a Change of Paradigm



It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change.

# Thank You

