

Human Dimensions

Vulnerability and Water Governance in Andean Drylands

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Adaptive Management of Water Resources under Climate Change in Vulnerable River Basins
Training Institute, La Serena, Chile, Oct. 8-17, 2012

Vulnerability and Water Governance in Andean Drylands

Expected changes in climate and **hydrology** will affect **agricultural production** in Andean drylands.

**What is the vulnerability of rural communities?
How will this fall upon rural poverty?**

It's not only a matter of knowing how vulnerable we are and if poverty will increase and how much; but also to obtain some insights about the **mechanisms of vulnerability and poverty production processes** associated with global environmental change

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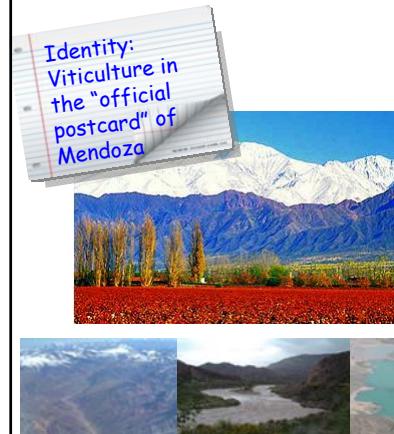
Andean drylands: 3 hydraulic societies

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Vulnerability and Water Governance in Andean Drylands

Andean drylands: 3 hydraulic societies

Mendoza River basin Mendoza, Argentina



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Andean drylands: 3 hydraulic societies

Mendoza River basin, Mendoza, Argentina

Export wine producers expanding uphill



Small grape producers in traditional areas of the oasis



Small / informal horticulture farmers



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Andean drylands: 3 hydraulic societies

Mendoza River basin

Mendoza, Argentina

Goat husbandry by indigenous people in the lower plains

Actors:
Who are they?
Interests?
Powers?
Alliances?



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Andean drylands: 3 hydraulic societies

Elqui River basin

Coquimbo Region, Chile



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Andean drylands: 3 hydraulic societies

Elqui River basin

Coquimbo Region, Chile

Horticulture and annual crops small producers

Irrigated: Export grape growers



Non irrigated lands:
Metallic minerals
Mining companies

Goat breeders



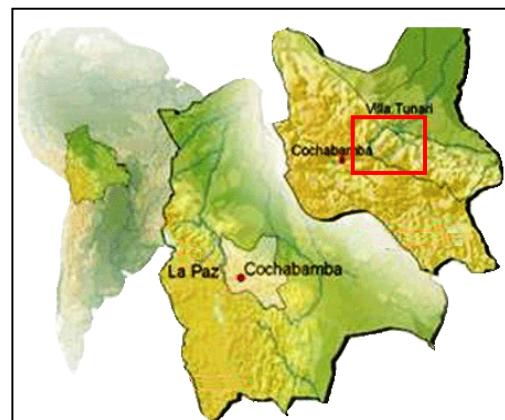
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Vulnerability and Water Governance in Andean Drylands

Andean drylands: 3 hydraulic societies

Pucara River basin

Cochabamba, Bolivia



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Andean drylands: 3 hydraulic societies

Pucara River basin

Cochabamba, Bolivia

Highlands of
K'aspicancha:
potatoes



Huaña kahua and Chirusi
small farmers:
corn, fruits and a few cows



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Vulnerability and Water Governance in Andean Drylands

Andean drylands: 3 hydraulic societies

Mendoza River basin Mendoza, Argentina	Elqui River basin Coquimbo, Chile	Pucara River basin Cochabamba, Bolivia
Export agriculture Small traditional farmers Desert goat breeders	Export agriculture Small traditional farmers Desert goat breeders Mining	Relatively homogeneity of traditional small producers
Water scarcity - Regulated surface waters – Partial access to groundwater		
“Democratic” distribution of surface water	Market driven Assignment of water 	Water market
Overlapping/disconnected formal institutions	Well organized formal institutions	Water management imbedded in comm. social organization
Welfare state	Neoliberal economy paradigm	consuetudinary laws
Identity of “water tamers” Invisibility of the desert & indigenous	“American style”	Indigenous president
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Vulnerable River Basins		

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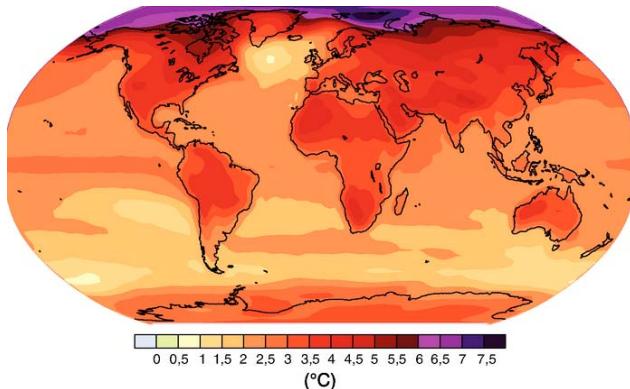
Global Environmental change scenarios

Vulnerability and Water Governance in Andean Drylands

Global Environmental change scenarios

Temperatures

Pauta geográfica del calentamiento en superficie: Cambios de la temperatura superficial proyectados para finales del siglo XXI (2090-2099).



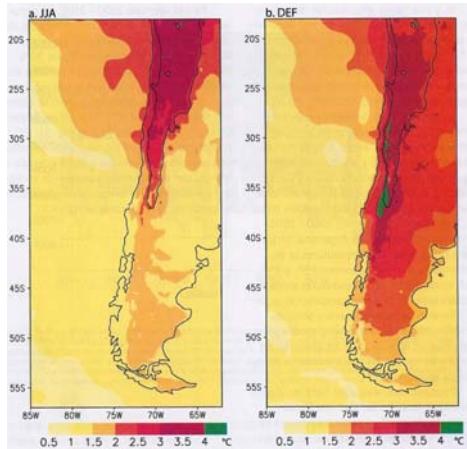
Nota: Se indica en el mapa la proyección multi-MCGAO promediada para el escenario A1B del IEEE. Todas las temperaturas tienen como referencia el período 1980-1999
Fuente: IPCC, 2007: Figura RRP.6.

Vulnerability and Water Governance in Andean Drylands

Global Environmental change scenarios

Temperatures

Cambios en las temperaturas medias de superficie ($^{\circ}\text{C}$) para el sector austral de América del Sur en invierno (JJA a la izquierda) y verano (DEF, a la derecha) para el intervalo 2070-2100 en relación a 1960-2000.



Fuente: Departamento de Geofísica, Universidad de Chile
<http://www.dgf.uchile.cl/ACT19/html/bases.html> Citado en: Villalba, R. y J. Boninsegna (2009:103)

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Global Environmental change scenarios

Temperatures

Mendoza, Argentina:

Variaciones esperadas en escenarios de CCG para el período 2020-2030 en cuencas de los Andes Centrales

Cuenca	San Juan	Mendoza	Tunuyan	Diamante	Atuel
Temperatura	+1.50°C	+1.50°C	+1.25°C	+1.25°C	+1.25°C
Precipitación	-105mm	-105mm	-105mm	-100mm	-100mm
Isoterma 0°C	+150mts	+150mts	+130mts	+130mts	+130mts

Fuente: Extraido de Boninsegna, José y Ricardo Villalba, 2007

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Global Environmental change scenarios

Temperatures

Chile central:

Zonas de calentamiento y enfriamiento entre 1979 y 2005



Fuente: Elaboración a partir de información de divulgación del proyecto ACT-119 "Variabilidad climática en Chile: evaluación, interpretación y proyecciones", Departamento de Geofísica, Universidad de Chile, <http://dgc.uchile.cl/ACT19/html/avances.html>

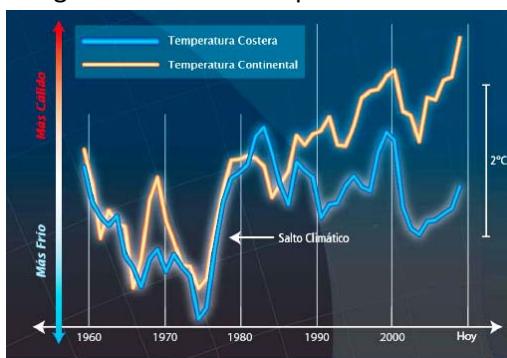
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Temperatures

Chile central:

Gráfico de divergencia entre las temperaturas costera y continental



Fuente: Elaboración a partir de información de divulgación del proyecto ACT-119 "Variabilidad climática en Chile: evaluación, interpretación y proyecciones", Departamento de Geofísica, Universidad de Chile,
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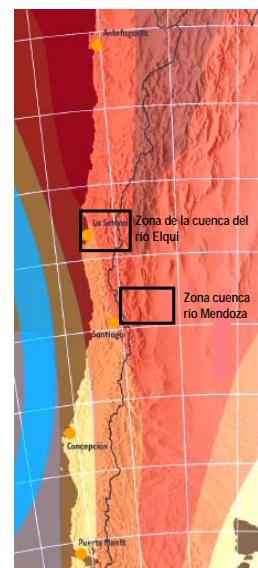
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Temperatures

Chile central:

Zonificación según calentamiento esperado



Fuente: Elaboración a partir de información de divulgación del proyecto ACT-119 "Variabilidad climática en Chile: evaluación, interpretación y proyecciones", Departamento de Geofísica, Universidad de Chile, <http://dgc.uchile.cl/ACT19/html/avances.html>

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Global Environmental change scenarios

Temperatures

Bolivia: Calentamiento observado y esperado

- El Servicio Nacional de Meteorología e Hidrología de Bolivia (SENAMHI) reporta que las temperaturas mínimas y máximas promedio en casi todo el norte del altiplano y los valles (incluyendo los de Cochabamba) se han **incrementado entre 0.8 y 1.5° C en los últimos 30 años**
- El Programa Nacional de Cambios Climáticos (PNCC) sugiere resultados similares. Las temperaturas promedio mínimas y máximas se han **elevado desde 1940 a 2004 en Santa Cruz, Beni, Cochabamba, Oruro, y Tarija, y han descendido en Chuquisaca y Potosí**
- Modelos sugieren **incrementos en las temperaturas de entre 0.8 y 1.4°C hasta el año 2030**, y grandes variaciones en las precipitaciones a lo largo y ancho de diferentes zonas geográficas.

Fuente: Oxfam Internacional, 2009a:27

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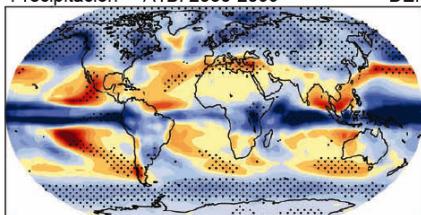
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Precipitations

Variaciones esperadas en las precipitaciones:

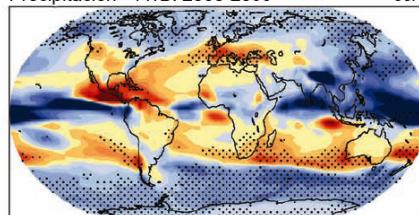
Disminuciones generalizadas de la precipitación estival en latitudes medias, excepto en el Asia oriental, donde aumentan

Precipitación A1B: 2080-2099 DEF



-0.8 -0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8 (mm/día)

Precipitación A1B: 2080-2099 JJA



-0.8 -0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8 (mm/día)

Nota: Estos cambios están basados en el escenario A1B del IE-EE, y corresponden al periodo 2080-2099 comparado con 1980-1999. Los puntos indican áreas en que la magnitud del valor medio del agregado multimodelos excede de la desviación típica entre modelos. Fuente: Bates et. Al., 2008: 27

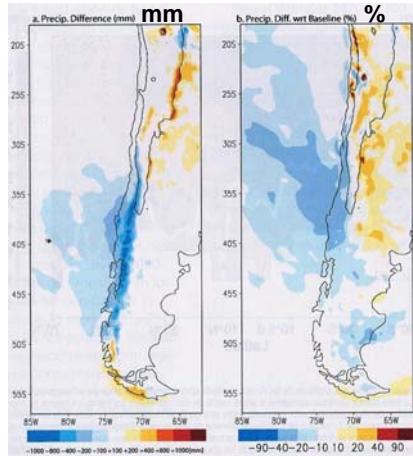
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Global Environmental change scenarios

Precipitations

Andes centrales:

Cambios en la precipitación total anual en milímetros (izquierda) y en porcentaje (derecha) para la región austral de América del Sur para el intervalo 2070-2100 en relación a 1960-2000



Fuente: Departamento de Geofísica, Universidad de Chile, <http://www.dgf.uchile.cl/ACT19/html/bases.html>. Citado en: Villalba, R. y J. Boninsegna (2009:108)

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Global Environmental change scenarios

Precipitations

Andes Centrales:

Alta variabilidad en la incidencia de las lluvias



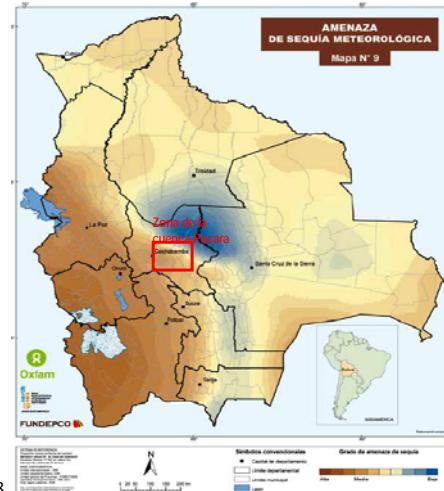
Fuente: Elaboración a partir de información de divulgación del proyecto ACT-119 "Variabilidad climática en Chile: evaluación, interpretación y proyecciones", Departamento de Geofísica, Universidad de Chile, <http://dgf.uchile.cl/ACT19/html/avances.html>

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Global Environmental change scenarios

Precipitations

Bolivia:
Mapa de amenaza de sequía
meteorológica



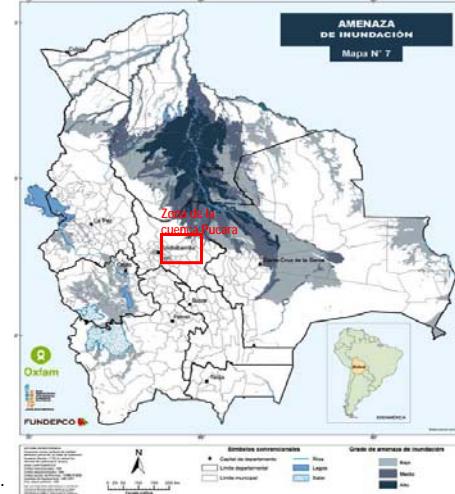
Fuente: Oxfam Internacional, 2009:18.

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Global Environmental change scenarios

Precipitations

Bolivia:
Mapa de amenaza de
inundaciones



Fuente: Oxfam Internacional, 2009:18.

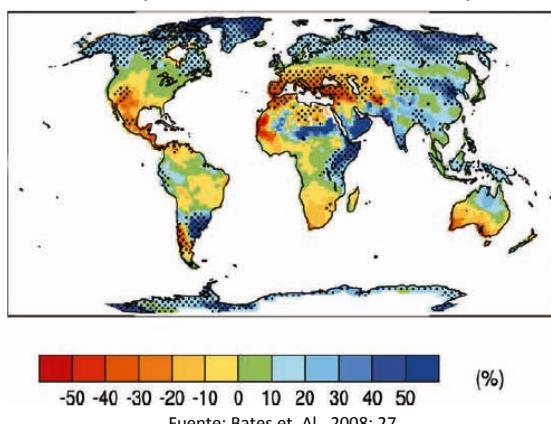
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Global Environmental change scenarios

River flows

Cambios esperados en la escorrentía.

Porcentaje de variación del periodo 2080-2099 en comparación con 1980-1999



Fuente: Bates et. Al., 2008: 27

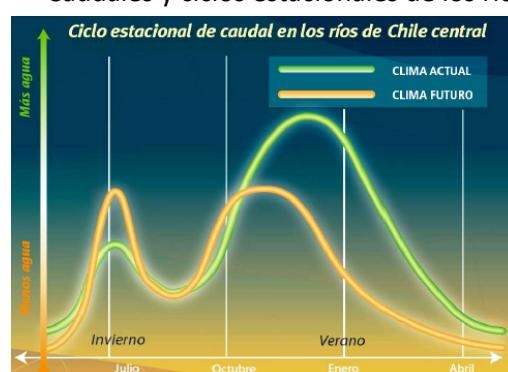
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Global Environmental change scenarios

River flows

Ríos de Chile Central:

Caudales y ciclos estacionales de los ríos



Fuente: Elaboración a partir de información de divulgación del proyecto ACT-119 “Variabilidad climática en Chile: evaluación, interpretación y proyecciones”, Departamento de Geofísica, Universidad de Chile,
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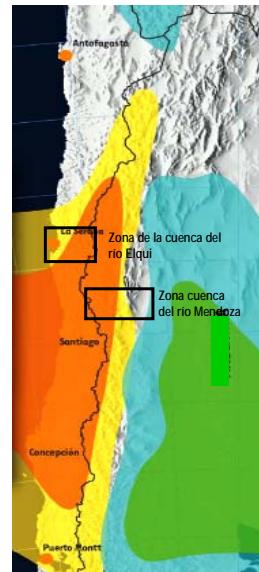
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Global Environmental change scenarios

River flows

Ríos de Chile Central:

Cambios proyectados de precipitaciones entre fines del siglo XX y fines del siglo XXI



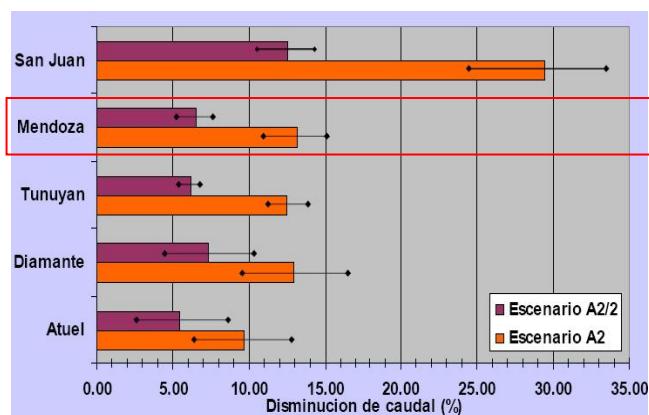
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Global Environmental change scenarios

River flows

Ríos del centro oeste de Argentina: Disminución de caudales esperados



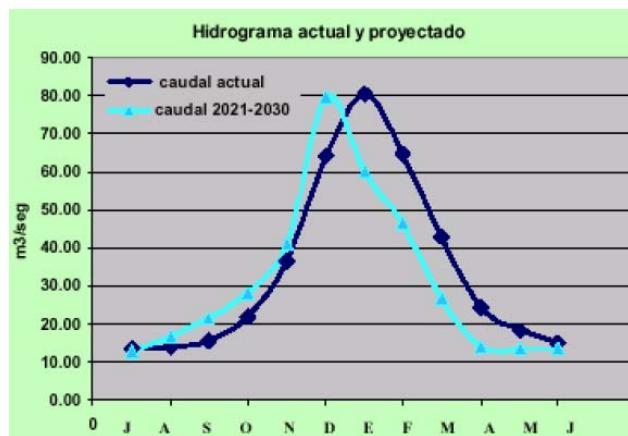
Fuente: Extraído de Boninsegna, José y Ricardo Villalba, 2007

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Global Environmental change scenarios

River flows

Río Mendoza: Variación del hidrograma esperado



Fuente: Extraido de Boninsegna, José y Ricardo Villalba, 2007

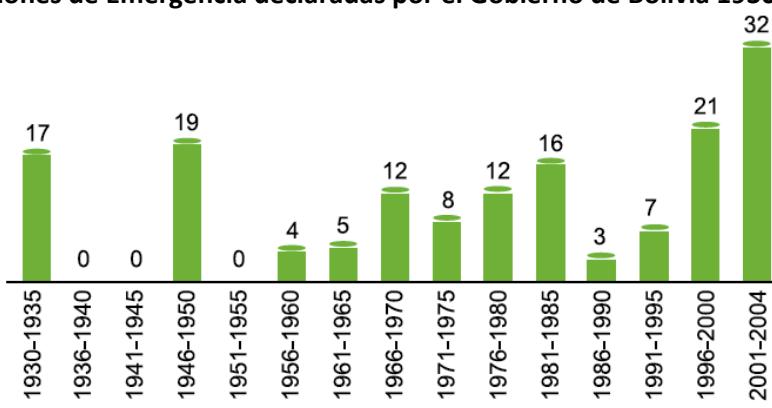
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Global Environmental change scenarios

Natural disasters

Bolivia:

Situaciones de Emergencia declaradas por el Gobierno de Bolivia 1930 - 2004



Fuente: Plan de Contingencias de Oxfam Internacional, 2009.
Citado en Oxfam Internacional, 2009:20

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Global Environmental change scenarios

Expected impacts

Bolivia:

Impactos esperados por regiones debido al cambio climático

Región	Escenarios de cambios	Impactos esperados
Valles Inter-andinos	<ul style="list-style-type: none"> •- Mayor concentración de la precipitación •- Mayor frecuencia de tormentas con menor número de días con lluvia •- Mayor frecuencia de granizo 	<ul style="list-style-type: none"> •- Competencia por el uso de agua •- Pérdida de la biodiversidad •- Incremento de las necesidades de agua para riego por los largos periodos sin lluvia •- Riesgos incrementados de deslaves, mazamorras y otros relacionados •- Problemas de generación de energía •- Erosión y desertificación de suelos

Fuente: PNCC, 2007: 69

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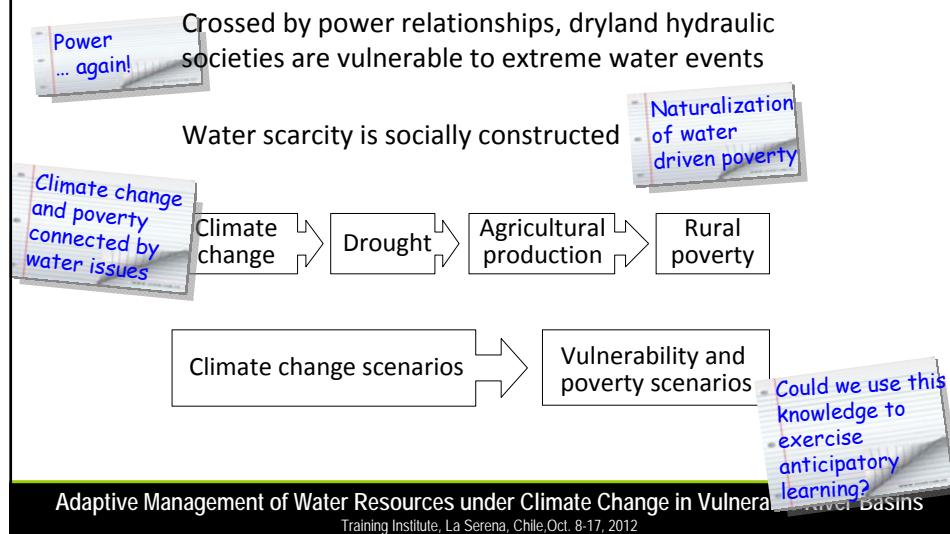
Global Environmental change scenarios

	Mendoza River, Argentina	Elqui River, Chile	Pucara, Bolivia
Mean temperatures	Higher	Higher in highlands Lower in the coast	¿?
Freezing	¿Less freezing?	¿Less freezing?	¿Less freezing?
Precipitations	Less in highlands More in lowlands	High variability	¿?
Hail	Probable		¿?
Glaciers	Shrinking	Shrinking	Shrinking
River flows	Diminishing	Diminishing	High variability
	Earlier spring flows		
Extreme events	Drought	Drought Mud slides	Drought Floods

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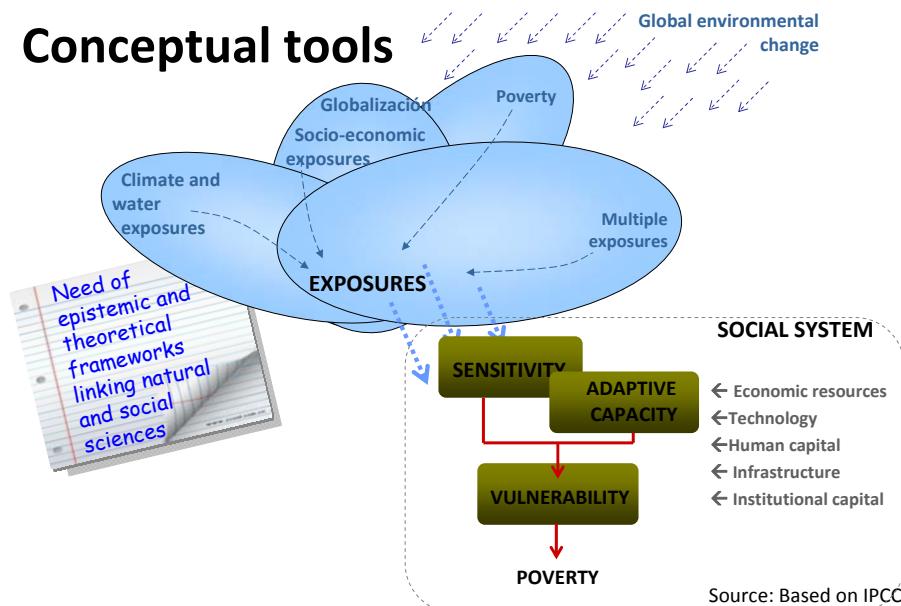
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Assumptions and research questions



Water, Global Environmental Change & Poverty in Andean Drylands

Conceptual tools



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Method

- Approach from the *critical/ecological inquiry* paradigm (Crabtree y Miller, 1992: 8,11-12)
- Mixed methodological design (Marshall y Rossman, 1989:45)
- Research strategy: study case (3) and selection of significant contexts (Valles, 2000) within each study case
- Information:
 - Secondary data
 - Observation
 - Semi-structured in-depth interviews

	Farmers/producers	Institutions
Argentina	46	25
Chile	11	5
Bolivia	21	---

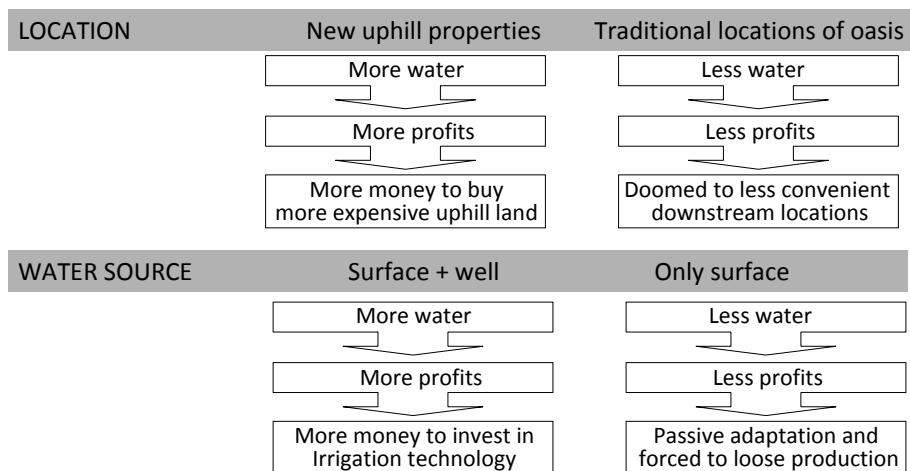
- Data processing:
 - Statistical sources: SPSS
 - Interviews: manual and NVivo

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Findings: Poverty/wealth equations

Reduction in river flows

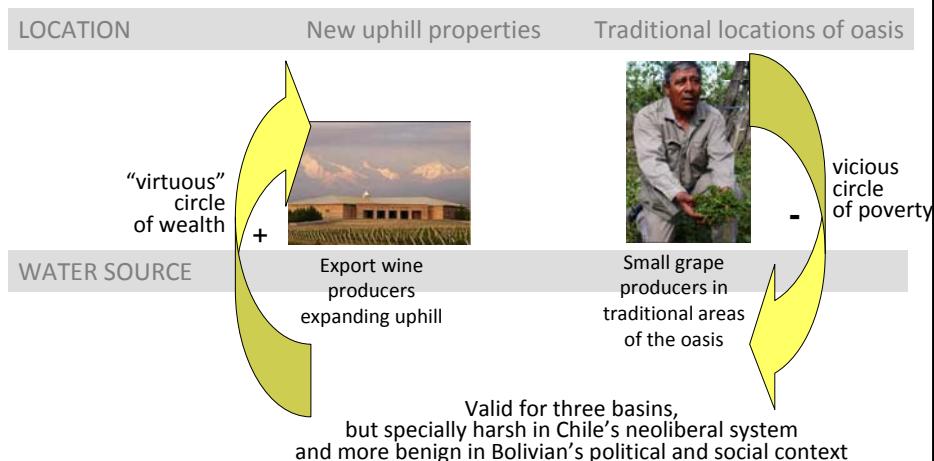


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Vulnerability and Water Governance in Andean Drylands

Findings: Poverty production processes

Reduction in river flows



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Vulnerability and Water Governance in Andean Drylands

Findings: Poverty/wealth equations

- 1) **Risk to "water safety":** reduction of water availability for domestic consumption (drinking, cooking, sanitary/health conditions).
- 2) **Risk to food safety & sovereignty:** threat to water used for food prod.
- 3) Water scarcity and disputes over water might affect poverty generation processes through less evident though **deeper and definitive means:**
 - loss of agricultural jobs
 - precarious rural employment
 - difficulties to stay rooted to the home town
 - deterritorialization
 - loss of lifestyle, of traditions and of ancestral knowledge
 - depreciation of productive and cultural minorities
 - stigmatization, marginality and exclusion in cities.

Channeled by water conflicts, the exercise of power deprives the weakest actors of their rights, impoverishing them

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Vulnerability and Water Governance in Andean Drylands

Findings: Poverty/wealth equations

Mendoza River basin, Mendoza, Argentina

Export wine producers expanding uphill



- Capital intensive export agriculture invests in adaptation to water scarcity
- Can afford more expensive uphill cooler locations

Small grape producers in traditional areas of the oasis



- Vulnerable because of double exposures (agribusiness)
- Low profits prevents them from investing for more efficient water use

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Vulnerability and Water Governance in Andean Drylands

Findings: Poverty/wealth equations

Mendoza River basin, Mendoza, Argentina

Small / informal horticulture farmers



- Vulnerable due to water sensitive crops
- Annual crops allows them to move in search of better climate/water conditions
- Vulnerable to double exposures (market problems)

Goat husbandry by indigenous people in the lower plains



- Affected by river water consumption upstream
- More vulnerable after the dam (meant for agriculture), as they do not have legal right to water
- Trapped in desertification and poverty spirals

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Vulnerability and Water Governance in Andean Drylands

Findings: Poverty/wealth equations

Elqui River basin, Coquimbo Region, Chile

Irrigated oasis: Export grape growers



- Water market allows competition for water with mining activities
- Affected by lack of rural labor

Irrigated oasis: small farmers growing vegetables and annual crops



- Migration in search for plots with water availability
- Vulnerable to double exposures (market problems)

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Findings: Poverty/wealth equations

Elqui River basin, Coquimbo Region, Chile

Non irrigated lands: goat breeders



- Have long lost their water and the possibility of breeding their goats, attending to their small orchard, raising their families there
- Emigration and loss of territorial bonds.
- Change in life style
- Surrender of the relative control they had over their food
- Lost identity as goat breeders

Non irrigated lands: Metallic minerals mining companies



- Socially legitimated by the profits they make

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Vulnerability and Water Governance in Andean Drylands

Findings: Poverty equations

Pucara basin, Cochabamba, Bolivia

- Old poverty patterns and lack of infrastructures and services
- Food security and food sovereignty is threatened while production of what is consumed is becoming increasingly separated from the household and from the community
- Resilience and adaptation potential to water/climate problems, imbedded in culture
- The official “right to not develop”, the “right to difference” and the objectives of “good living” revitalize indigenous cultures and the harmony with nature, and are a favorable setting to solve conflicts taking into consideration the interests of the commons.
- Most issues are addressed and controlled from the community base and not so much by market forces or external public policies.



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Vulnerability and Water Governance in Andean Drylands

Findings: Poverty production mechanisms

Mendoza River basin
Mendoza, Argentina

Elqui River basin
Coquimbo, Chile

Pucara River basin
Cochabamba, Bolivia

Water inherent to the land	Water market	Customary laws
“Neowelfare” policies	Neoliberal policies	Indigenous at formal power
Agribusiness rules tend to control agricultural circuits driving the weaker players out of the system		Prevalence of mixed market /subsistence agriculture
“Fractious development”	Hard-line development	Ethno-cultural life style
“Water tamers” identity protects most dynamic viticulture actors	Competition paradigm	“Good living” philosophy
“Water tamers” identity makes desert herders invisible		

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Vulnerability and Water Governance in Andean Drylands

Findings: Poverty production mechanisms

- We identify **poverty production processes**, most of them beyond the local sphere. They are related to **rules** that make some wealthy and others poor.
- In general, poverty production processes are being **reinforced** by water and climate changes
- To deactivate these processes, it is necessary to (also) operate on the **power relations** of the hydraulic societies
- Neoliberal social and economical regulation devices (such as markets) and ideological and other **symbolic devices** (such as official identities), magnify these processes
- **Social cohesion** and organization and **locally determined development** objectives in decision making processes minimize them
- Adaptation to climate change appears as an **opportunity for poverty combat**

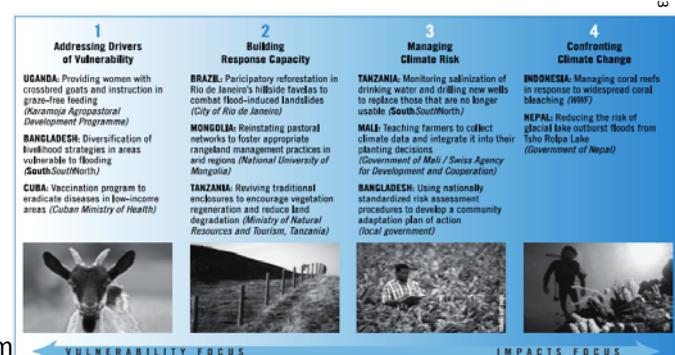
Poverty perpetrators,
that are not only
powerful actors but
also capitalist
institutional
arrangements

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Training Institute, La Serena, Chile, Oct. 8-17, 2012

Vulnerability and Water Governance in Andean Drylands

Poverty scenarios: Adaptation for poverty reduction

- Adaptation or mitigation
- Adaptation for resilience or adaptation through change
- Poverty policies vs. adaptation policies : difficult synergies due to different epistemic bases.
- Adaptation continuum



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