

ECOLOGY AND GROUNDWATER: A CASE STUDY IN A TRANSBOUNDARY LATIN-AMERICAN RIVER (LAUCA RIVER)

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LAUCA RIVER

- $Q=2,6 \text{ m}^3/\text{seg}$ (average measured in Chile)
- m.a.s.l. : + 4000m
- Headwaters at Cotacotani lagoons
- River mouth at salar de Coipasa, Bolivia
- Geopolitical boundaries : established more than two centuries ago, using the highest mountains as a border
- Total lenght: 225 km

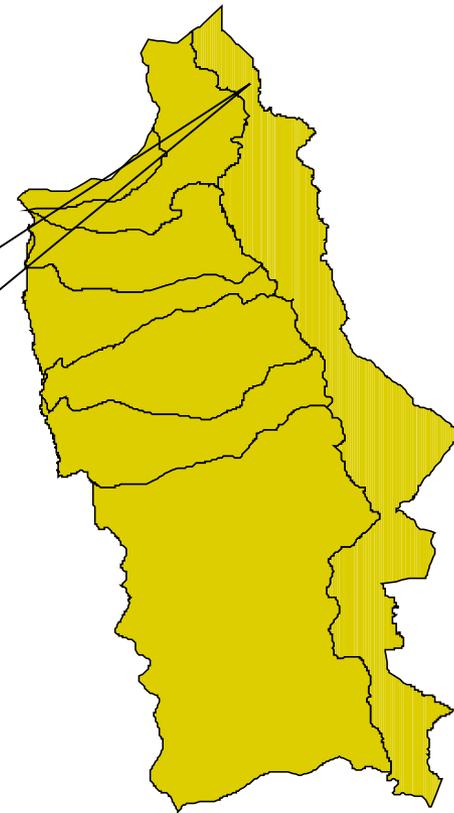
Lauca national park, Unesco



Source: www.clinamen.cl



Study site

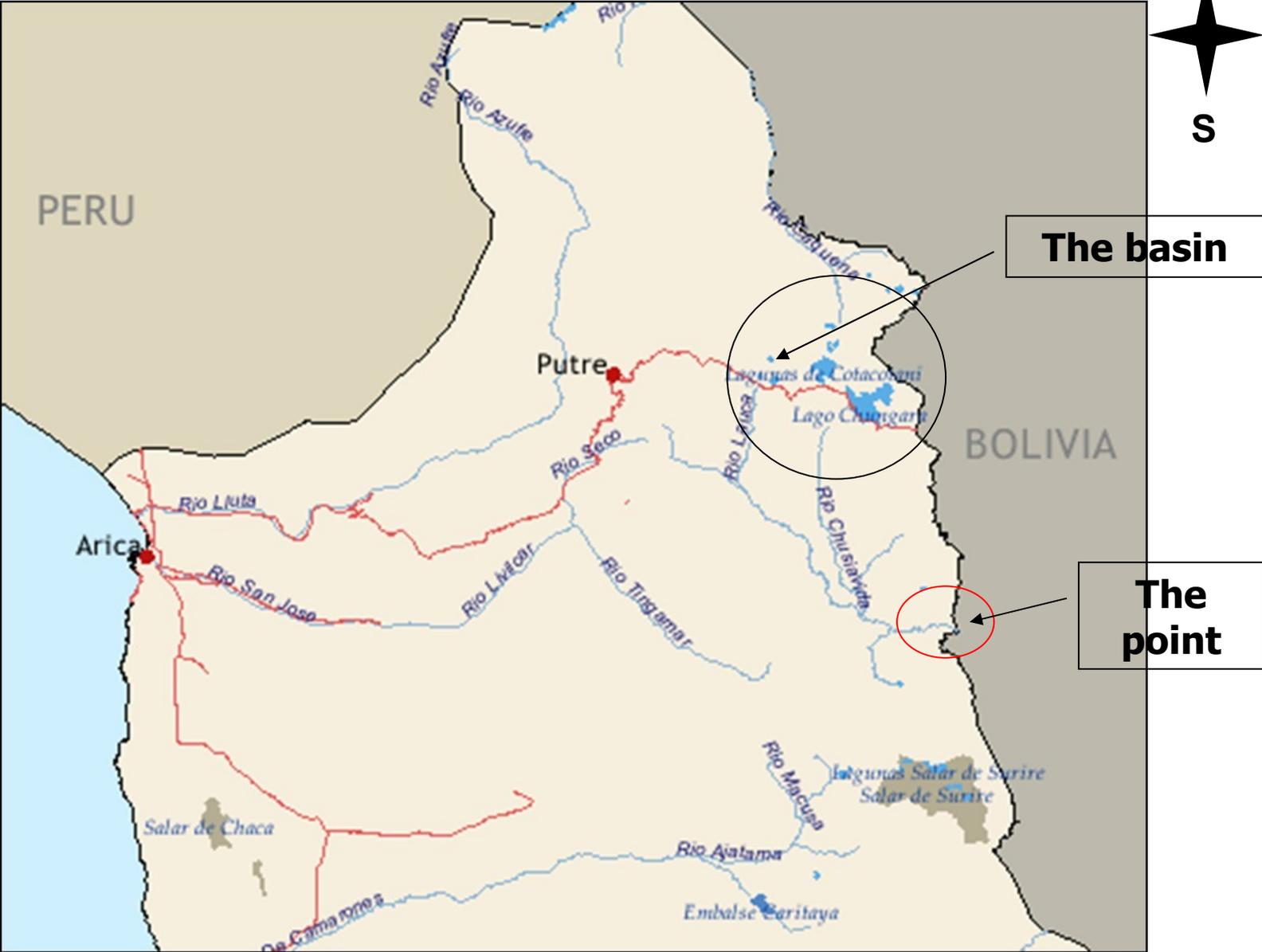


Chile

Region of Tarapacá

Lauca river (18°12'S-69°18'W)

Transboundary basin of Lauca river



LAUCA RIVER NATIONAL PARK CHILE

This park have 137.883 has, was established as biosphere reservation of the world by **UNESCO**. This area also has Surire salar and the national park of Las Vicuñas, accounting in total 358.312 has.

Lauca river



Fuente: www.wits.ac.za

Surire Salar



Fuente: Jordy Galla

GROUNDWATER ASSAY

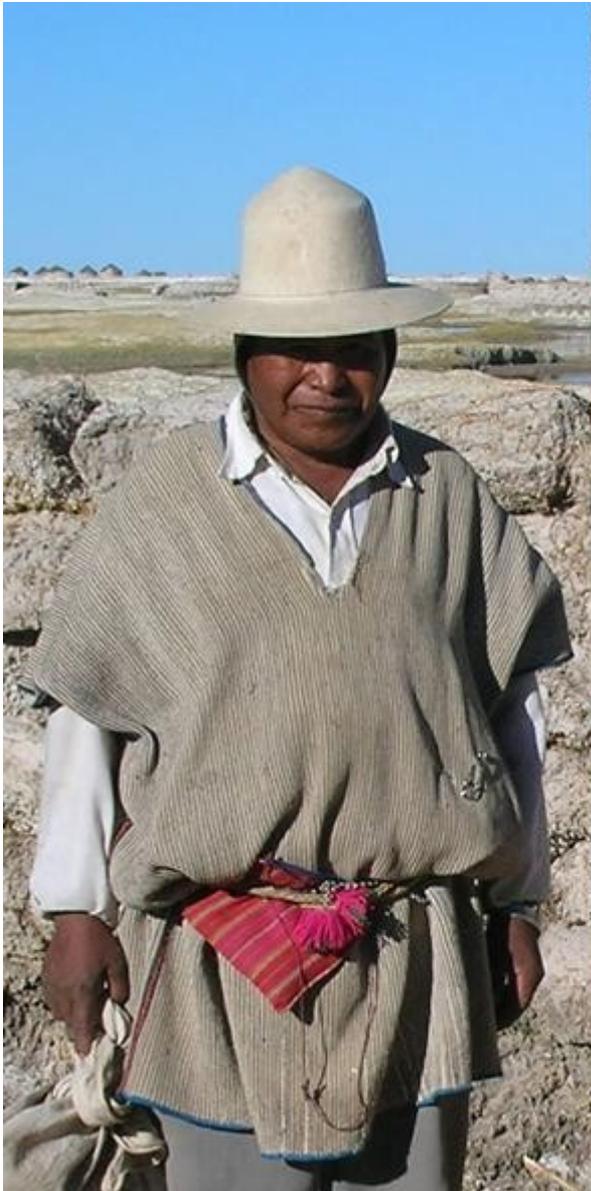
- Isotopic techniques are powerful tools in order to define water origin.
- From 9 wells located in Lauca bed, estable isotopic deuterium and ^{18}O where used for this purpose.
- Adding a known amount of radioisotope into a known volume of water, the evolution of concentration and the origin of groundwater in relation to surface water was established.
- As a result, pumped groundwater has a minimum effect on surface Lauca river water (less of 20%).
- Lauca river has a low conductivity ($770\mu\text{S}/\text{cm}$) which may allow dilution and decreasing Arsenic and Boron.





The eco-economical research problems:

- At Lauca basin, flora, fauna and human beings have been developed under extreme conditions of cold, UV radiation and salty soils and water.
- The peasants of altiplano lands (Aymaras and Chipayas) tolerate alternative periods of drought and rains and these conditions have been sharpened during the last decades.
- The average annual precipitation is 380mm, concentrated from december to march and the annual potential evaporation is 1500mm.
- The scarcity of water is one of the most limiting factors for socioeconomic development (Ríos y Aparicio, 2007)
- This extreme conditions are variable from time to time at different location within the altiplano ecosystem, each population has optimal conditions to thrive.
- If this condition are further stressed for economic reasons, no flora, fauna or humans can move its tolerance range into historical time and this would produce irreversible ecological changes.



Los Chipayas

2,500 a.c.

Dos poblaciones

1,850 hab.

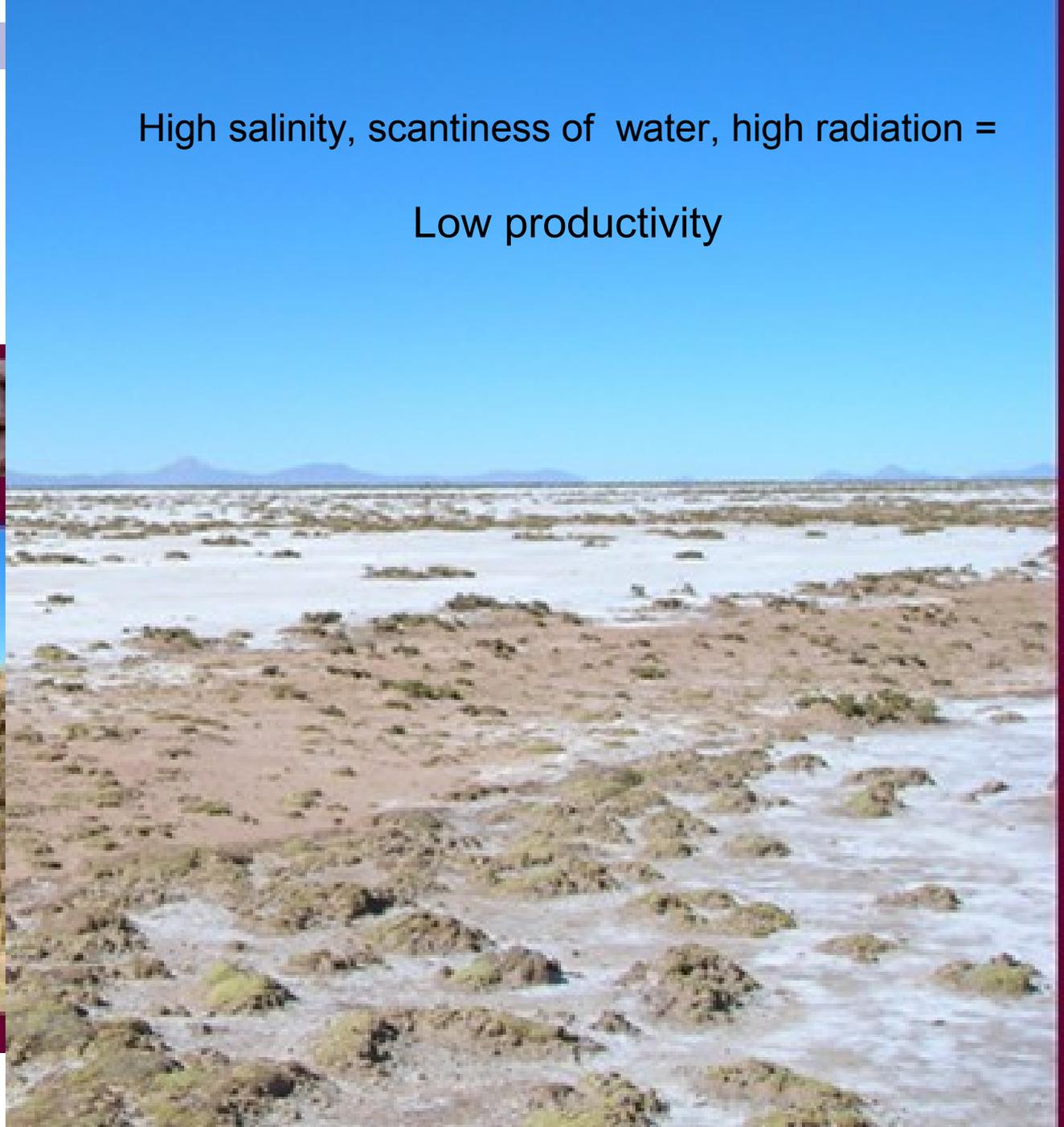
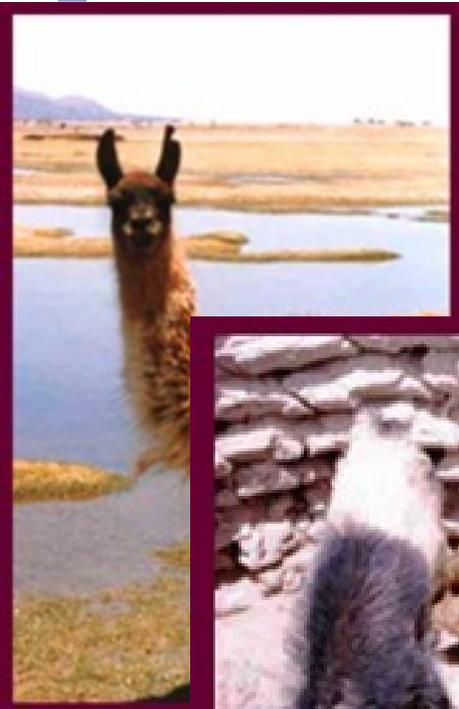
Idiomas

Pobreza: 96.64%

Agricultores,
ganaderos,
cazadores y
pescadores

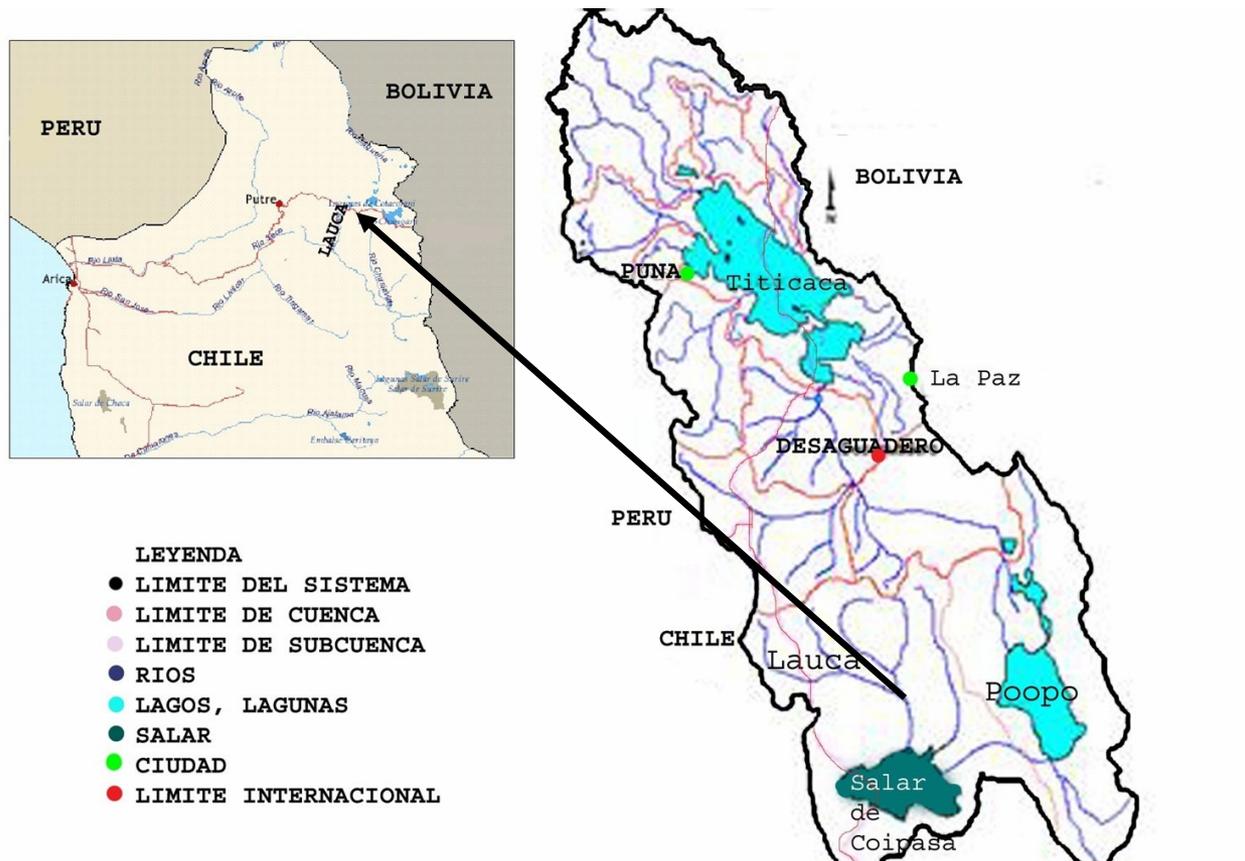
Image source: Ríos y Aparicio, 2007, Bolivia

High salinity, scantiness of water, high radiation =
Low productivity



Geographical and historical references

Ancient disagreement with Bolivia for using waters into Chilean side.
Diplomatic relationships between both countries were broken since 1962.



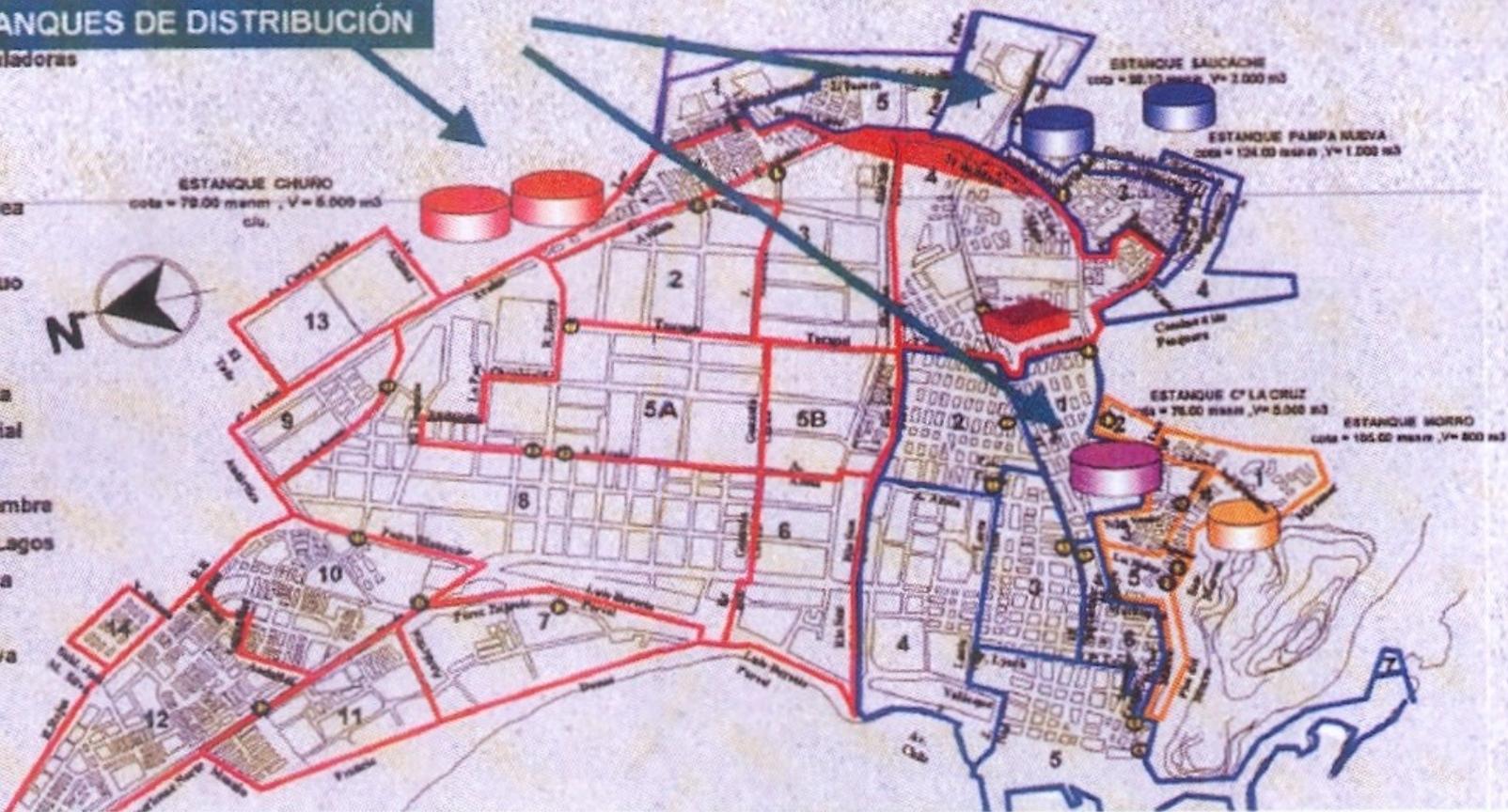
Titicaca, Desaguadero, Poopo and Coipasa system and Its connection whit Lauca River

Source: Original design

ESTANQUES DE DISTRIBUCIÓN

Estaciones Reguladoras

- 0 Industriales
- 1 Lastarria
- 2 Sargento Aldea
- 3 Latorre
- 4 Centro Antiguo
- 5 Centro Alto
- 6 La Lisera
- 7 Renato Rocca
- 8 Zona Industrial
- 9 Juan Noé
- 10 11 de Septiembre
- 11 Villa Pedro Lagos
- 12 Tierra Blanca
- 13 Magisterio
- 14 Pampa Nueva
- 15 Balmaceda
- 16 Loa
- 17 Cotacotani
- 18 Papudo



Mapa de la ciudad de Arica y su respectiva sectorización para abastecimiento de agua potable.

Source: Ministerio Obras Públicas, Chile

Azapa valley profit of remnant water developing an olive plantation exported to many countries in the world



Exportation olive volume from Azapa valley toward the world

Source Universidad de Tarapacá, Arica, Chile, 2008



Final comments:

- As freshwater scarcity increases, conflict over allocate scarce water resources will continue to grow.
- Since national borders usually cut across watersheds, much of this conflict, as well as attempts to solve or prevent it, is likely to be international in scope.



Bibliography

- Maira, L. y Murillo de la Rocha, J. 2004. El largo conflicto entre Chile y Bolivia. Dos visiones. Aguilar Chilena de Ed. S.A. Santiago de Chile. 196 pp.
- Ríos, J. N y Aparicio J. 2007. La evaluación de la vulnerabilidad y capacidad de adaptación al cambio climático, como instrumento estratégico de planificación para el desarrollo sustentable del cambio indigena Chipaya, Oruro Bolivia.



Gracias!!!

Payachatas
Source: Piere pisano