Correlation between Access to Capitals and Income in the Bolivian Altiplano

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Introduction

The livelihood strategies of Bolivian Altiplano households are shaped by the capitals they access and control (Valdivia and Quiroz, 2003). Every household forms its own livelihood strategy to survive and increase quality of life. Households construct their strategies in part based on how available resources interrelate and affect access to other resources. This poster uses survey data from households in the Bolivian Altiplano in 2006. We investigate correlations between household access to capitals and the household's total income as a proxy for wellbeing, and the correlations between capitals learn about feedback loops within capitals.

Sustainable Livelihoods Model

The sustainable livelihoods (SL) approach is useful for assessing how and why individuals or household units make their decisions. The SL approach models the household's ability to sustainably provide for itself within the complex system of its environment (Scoones, 1998). That environment includes the resources to which households have access; the institutions, natural systems, history, economy, and policies that impact the households; the livelihood strategies that they construct; and the outcomes that the strategies produce. The SL framework "offers a way of thinking about livelihoods that helps order complexity and makes clear the many factors that affect livelihoods" (DFID, 1999, p. 2).

Within the SL framework, a household's resources are often divided into categories or capitals. This project uses four capitals: natural, human, social, and productive (Table 1). We use the four capitals to identify correlations in resource access and correlations between access and total household income.

Table 1. Model

Capital	Variable	Construction
Human	Education	Education of the head of household
	Skills	No. of members with skills outside of agriculture
	AE	Adult Equivalent*
Social	Networks	Sum of household members that work outside of the community
	Organizations	Total number of formal organizations that the household participates in
Natural	Land	Natural log of total hectares used to grow crops
	TLA	Tropical Animal Units
Productive	Irrigation	Hectares irrigates
	Alfalfa	Alfalfa as an indicator to uptake of improved dairy methods (hectares)
Dependent Variable	Income	Includes cash and in-kind income

* AE=1 for age>17.5, AE=.5 for 17.5>age>12.5, AE=.3 for 12.5>age>5.5, AE=0 for age<5.5

Data

The dataset was collected in 2006 by the household survey "Cuestionario de Estrategias de Vida, Capitales, y Prácticas Ciclo 2005-2006"[3]. The survey includes a total of 330 households located in two regions of the Bolivian Altiplano: Umala and Ancoraimes (Figure 1). Each region is characterized by different climates, access to resources, and major income sources.
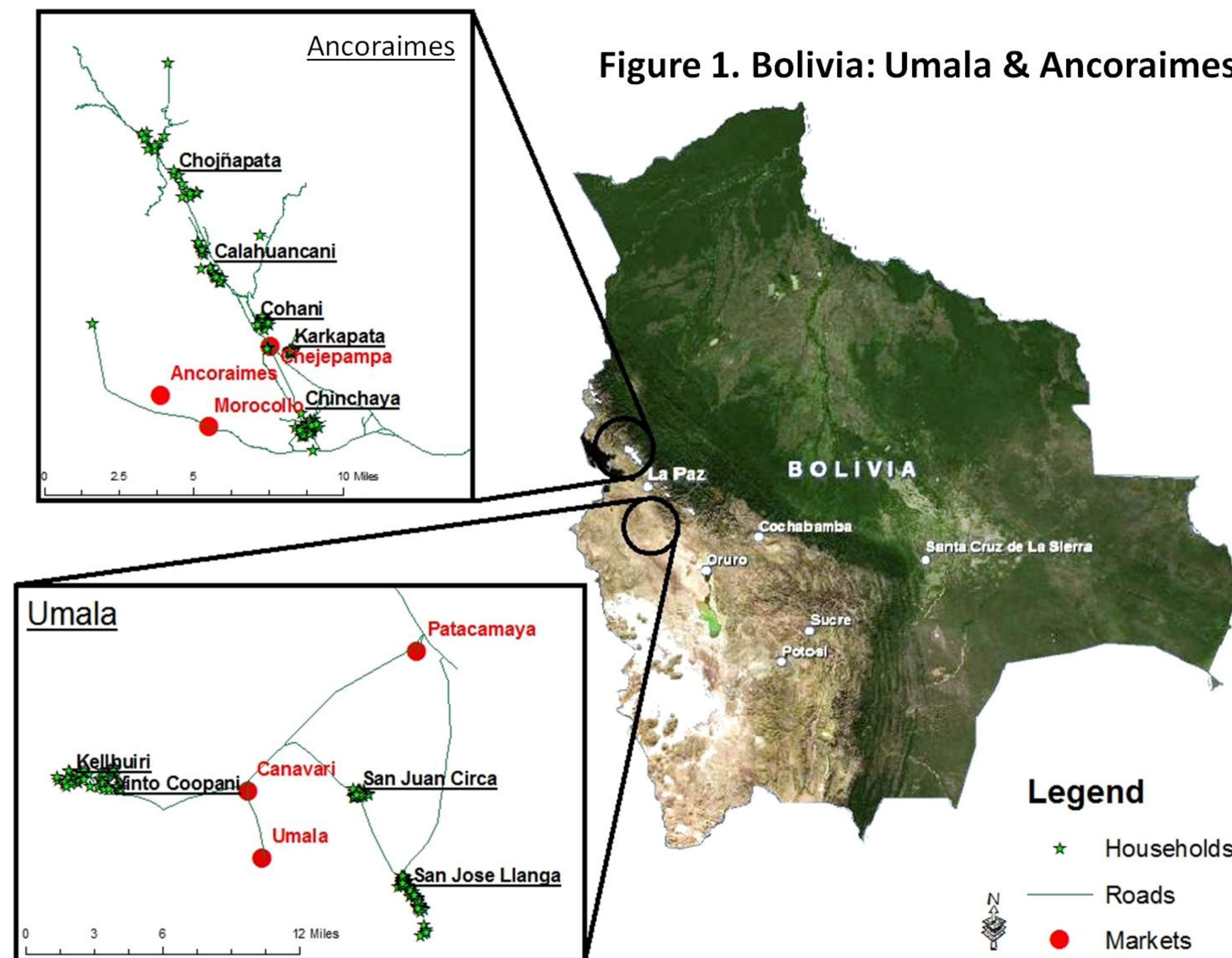
Figure 1. Bolivia: Umala & Ancoraimes

Ancoraimes
Chojñapata
Calahuancani
Cohani
Karkapata
Ancoraimes
Chejepampa
Morocollo
Chinchaya

Umala
Kellhuiri
Vinto Coopani
Canavari
San Juan Circa
Umala
Patacamaya
San Jose Llanga

BOLIVIA
La Paz
Cochabamba
Oruro
Sucre
Santa Cruz de la Sierra
Potosí

Legend
★ Households
Roads
● Markets

Table 2. Differences Between Access to Capital and Income between Regions

Region	Umala	Ancoraimes	Wilcoxon R-S p-value
AE	4.46	3.54	.001
Ed.	7.02	6.11	.030
Skills	0.64	1.02	.001
Networks	2.22	2.50	.120
Orgs.	1.51	0.97	<.0001
Land	4.82	0.55	<.0001
TLU	9.57	6.99	<.0001
Alfalfa	1.57	0.04	<.0001
Irrigation	0.05	0.06	<.0001
Income	18,092	6,851	<.0001

Table 3. Robust Regression: Income's Response to Capitals (R²=.46/.31)

Region	Intercept	AE	Ed.	Skills	Networks	Orgs.	Land	TLU	Alfalfa	Irrigation
Umala	2,120	323.2	320.0**	2,744***	8.91	-847.0	5,189***	276.0**	546.4	2,841
Ancoraimes	6,378***	117.5	109.1	1,173***	-314.3*	175.1	3,004***	95.5**	2183	-27.75

***=Significant at α=0.01, **=Significant at α=0.05, *=Significant at α=0.10

Table 4. Umala: Kendall Tau b Correlation Coefficients, N = 181

Table only shows significant values (p-value≤0.1)

	AE	Ed.	Skills	Land	TLU	Networks	Orgs	Alfalfa	Irrigation
AE	1.000			0.153	0.181	0.244	0.124	0.105	
Ed.		1.000	0.244	0.201	0.139		0.191	0.127	0.132
Skills		0.244	1.000			0.107			
Land	0.153	0.201		1.000	0.321	-0.106	0.180	0.625	
TLU	0.181	0.139		0.321	1.000		0.263	0.224	0.120
Networks	0.244		0.107	-0.106		1.000			
Orgs	0.124	0.191		0.180	0.263		1.000	0.147	0.261
Alfalfa	0.105	0.127		0.625	0.224		0.147	1.000	
Irrigation		0.132			0.120		0.261		1.000

Table 5. Ancoraimes: Kendall Tau b Correlation Coefficients, N = 149

Table only shows significant values (p-value≤0.1)

	AE	Ed.	Skills	Land	TLU	Networks	Orgs	Alfalfa	Irrigation
AE	1.000	0.145			0.131		0.215		0.120
Ed.	0.145	1.000		0.171		-0.133	0.270		
Skills			1.000		-0.201				0.138
Land		0.171		1.000	0.143			0.377	
TLU	0.131		-0.201	0.143	1.000	0.154			-0.115
Networks		-0.133			0.154	1.000			-0.183
Orgs	0.215	0.270					1.000		
Alfalfa				0.377				1.000	
Irrigation	0.120		0.138		-0.115	-0.183			1.000

Analysis

At the regional level, sample sizes and a distribution that is not near normal required the use of nonparametric methods. A Wilcoxon ranked sum (R-S) test is used to determine for which variables "region" plays a significant role. Robust regression, which reduces the impact of outliers and does not require homoscedasticity, is used in order to test if the relationship between capitals and income expected in the livelihoods model exists in the dataset. Kendall's Tau is used to determine correlations between variables within each region. The results were cross-checked with Spearman's correlation for robustness.

Results

Although the regions are less than 200 kilometers apart, differences and in history and divergence have created large differences in access and income. Land fragmentation and population pressure in Ancoraimes have produced low levels of access to natural capital, leading households to invest in production-increasing technology and to choose livelihood strategies that depend on off-farm labor (Table 2).

The results of the robust regression express a relationship between natural capital, human capital, and income that supports the use of the livelihoods model. The social capital and productive capital variables are either not significant or are not in the expected direction (Table 3). The model is able to account for over 30% of the income variance in each region.

Analyzing the correlations between capitals illuminates relationships that are not evident in the regression analysis. Between capitals, 30 of the 35 significant relationships are positive. Consistent with the literature, increased access to or investing in an individual's access to capital is associated with greater access to other capitals. Positive correlation may indicate feedback loops that help to build asset portfolios and critical thresholds, which cause divergence in access and investment (Barrett & Swallow, 2006; Lopez & Servén, 2009).

The correlations analysis provides insight into how the capitals relate. In Umala, membership in organizations is positively correlated with many of the other capital variables, indicating social capital's role as a mechanism for increased access, as discussed by Bebbington (1999). In the case of Ancoraimes, education of the head of the household is not significant in the regression, but has significant relationships with family size, access to land, employment outside of the community, and participation in organizations. Without education during childhood, household leaders have greater difficulty accessing many of the capitals that families depend on.

Conclusions

- History and geography have lead to a significant divergence in household livelihoods in regions that are near each other in the Central Altiplano.
- Regression indicates a significant and positive relationship between each of the capital categories and income, consistent with the livelihoods model.
- In both regions, the majority of significant correlations between capitals are positive, indicating the significant role that access to capital plays in building greater access.
- Multiple positive correlations also indicate that a household's entire portfolio of assets is vulnerable to shocks within a single asset.

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