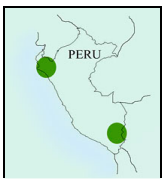

Climate vulnerability, local knowledge and adaptation to climate impacts in Peru

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Smallholder agriculture along the Northern Peruvian coast and the Peruvian Altiplano is under considerable strain due to weather extremes such as droughts, floods, frosts and hails. Climate risk management is therefore essential for improving rural livelihoods. Among the adaptation options, diversification of livelihood strategies and more efficient communication of scientific climate forecasts are valuable entry points to reduce climate vulnerability.

Climate vulnerability

Peru's high exposure to extreme weather events is reflected in the local perception on severity and spatial distribution of hazardous events. Table 1 gives an example of the severity of climate events as perceived by six communities of the Altiplano. Given high levels of poverty in many rural areas such as in Piura and the Peruvian Altiplano, climate impacts are especially severe. Besides destroying important productive assets, climate hazards cause increases in child mortality, decrease in school attendance and disruption of social networks due to migration.

Severity	Community					
	Alto Aychuyo	Ancacca	Candile	Cari Cari	Santa María	Yanamocco
1	Hail	Frost	Floods	Frost	Drought	Frost
2	Snow	Drought	Drought	Drought	Floods	Drought
3	Frost	Floods	Frost	Hail	Hail	Flood
4	Drought	Hail	Hail	Flood	Frost	Hail
5	Flood	Show	Snow	Snow	Show	Snow
6	Winds	Wind				

Table 1. Local perception on severity of climate hazards in Puno, Altiplano.

Livelihood strategies

Cluster analysis of important livelihood strategies in two communities of the Altiplano for the 1990s shows that four typical groups of smallholders can be distinguished - the food crop producers, two groups of dairy producers and the elderly (Fig. 1). These four typical groups display distinct capacity to adapt to climate stress. Households with a large number of livestock such as the food crop and dairy producers can better adapt to climate shocks. Dairy production from improved cattle was a secure source of cash income in the late 1990s since prices were subsidised. Especially freeze-dried potatoes (chuño, tunta) are an important buffer for food security when harvests fail.

Cluster Analysis: Anccaca (1999-2000, n=58) and Santa María (1999-2000, n=52)

Characteristics	Food Crop	Dairy II	Dairy I	Elderly
Sheep (criollo)	21	4	10	2
Cattle (criollo)	6	2	1	1
In-kind income (Soles)	642	406	638	252
Sales cattle (Soles)	446	1192	282	163
Age	37	35	38	65
Non-agric. income	1874	5290	2004	514
Improved cattle	0	1	4	3
Improved sheep	2	4	16	5

Characteristics	Food Crop	Dairy I	Dairy II	Elderly
Sheep (criollo)	7	3	2	0
Sales cattle (Soles)	1261	727	597	163
Cattle (criollo)	3	0	1	1
Labour (units)	2,7	4,5	3	2,6
Age	46	54	35	73
Non-agric. income	657	634	2067	1620
Improved cattle	0,4	3	2	0,5

Adaptation potential: GREEN high, GREY medium, RED low

Figure 1. Adaptation potential of typical smallholder households in the Altiplano.

Local climate forecasting

In Piura and the Peruvian Altiplano, climate forecasts issued by SENAMHI are weakly integrated into local knowledge networks. Generally it is difficult to translate the climate information on average temperatures or the total amount of rainfall during the cropping season into how they may impact crop yields.

Difficulties to understand and different interpretation of local indicators create little incentive to use the given information. For example, almost half of the population in six communities in the Altiplano did not trust the El Niño forecasts in 1997 (Tab. 2). Instead, forecast information is mainly used from sources based on local knowledge networks (Fig. 2). Local knowledge networks are radial and organised around neighbourhoods with forecast information being accessed by exchange or observation of neighbours.

Table 2. Use and trust of El Niño information in six communities of Puno, Altiplano.

Community	Total	Main Information Source	Did Listen	Did not Listen	Use		Trust		Did Not Vote
					Yes	No	Yes	No	
Anccaca	56	Radio, TV	31	14	17	14	20	11	11
Aychuyo	42	Radio	12	30	4	7	4	7	0
Candile	53	Radio, TV	27	12	12	15	13	14	14
Cari Cari	37	Radio	22	3	13	9	17	5	12
Santa María	46	Radio	23	21	16	6	14	9	2
Yanamocco	31	Radio	9	13	5	4	5	4	9
TOTAL	265		124	93	67	55	73	50	48

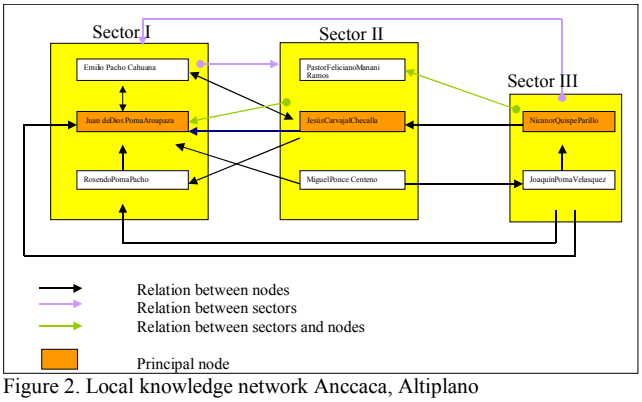

Figure 2. Local knowledge network Anccaca, Altiplano

Major barriers for distributing climate forecasts are that the one-way communication of scientific forecasting does not allow for consultation or feedback and the local believe that forecasts are only valid for the location where they were generated. The acceptance of climate forecasts furthermore depends on who communicates the information. Government institutions are often not trusted.

Differing from scientific approaches, communities in Piura perceive that mainly major El Niño events impact on their agricultural production. This needs to be taken into account when distributing scientific forecasts to these communities. In contrast, communities in the Altiplano region relate El Niño events largely to impacts in Northern Peru and it is therefore questionable whether strengthening awareness of El Niño is useful.

Regional adaptation strategies

Different strategies to adapt to climate impacts are employed in the two regions:

Piura
- Selling of livestock
- Over-harvesting in dry forest, deforestation
- Collective work during floods
- Individual strategies during droughts
- Migration of adult males and youth to jungle and coast

Altiplano
- Selling of livestock
- Selling of wool and handicraft
- Stinting food in family
- Informal trade
- Migration of adult males and youth to jungle and coast
- Accessing non market institutions for land, seed and labour (social reciprocity relations)

While in the Altiplano region general effective adaptation measures include decision making based on the Aynoka system, dehydration of potatoes and cultivating on higher grounds, households follow further important adaptation strategies according to their vulnerability. For example, more vulnerable households exchange wool for meat and potatoes, whereas less vulnerable households with diversified portfolio provide employment opportunities and fields to the more vulnerable.

Barriers to adaptation

As shown below, there are a number of similar barriers to adaptation in the two regions. However, distinct barriers can be identified in each region.

In both regions
- Limited understanding and access to local and regional governance structures
- Progressive loss of assets leading to poverty trap
- Lack of access to credit
- Lack of insurance mechanisms
- Lack of technological alternatives
- Lack of trust on information of forecasts
- Erosion of social structures and local knowledge due to migration

Piura
- Isolation during periods of drought
- Flood relocation conflicts
- Long periods of stress during dry years

Altiplano
- Multiple and consecutive shock events
- Uncertainty of climate events
- Lack of knowledge and understanding of the hail, frost, and flood events

Besides strategies developed and applied without assistance, communities in the Altiplano identified adaptation measures, for which they would need external assistance among them effective early warning systems, school feeding programs during food shortages, credits for sheds and seeds along with fixing drainage systems and pursuing greenhouses and water pumps being most important.

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