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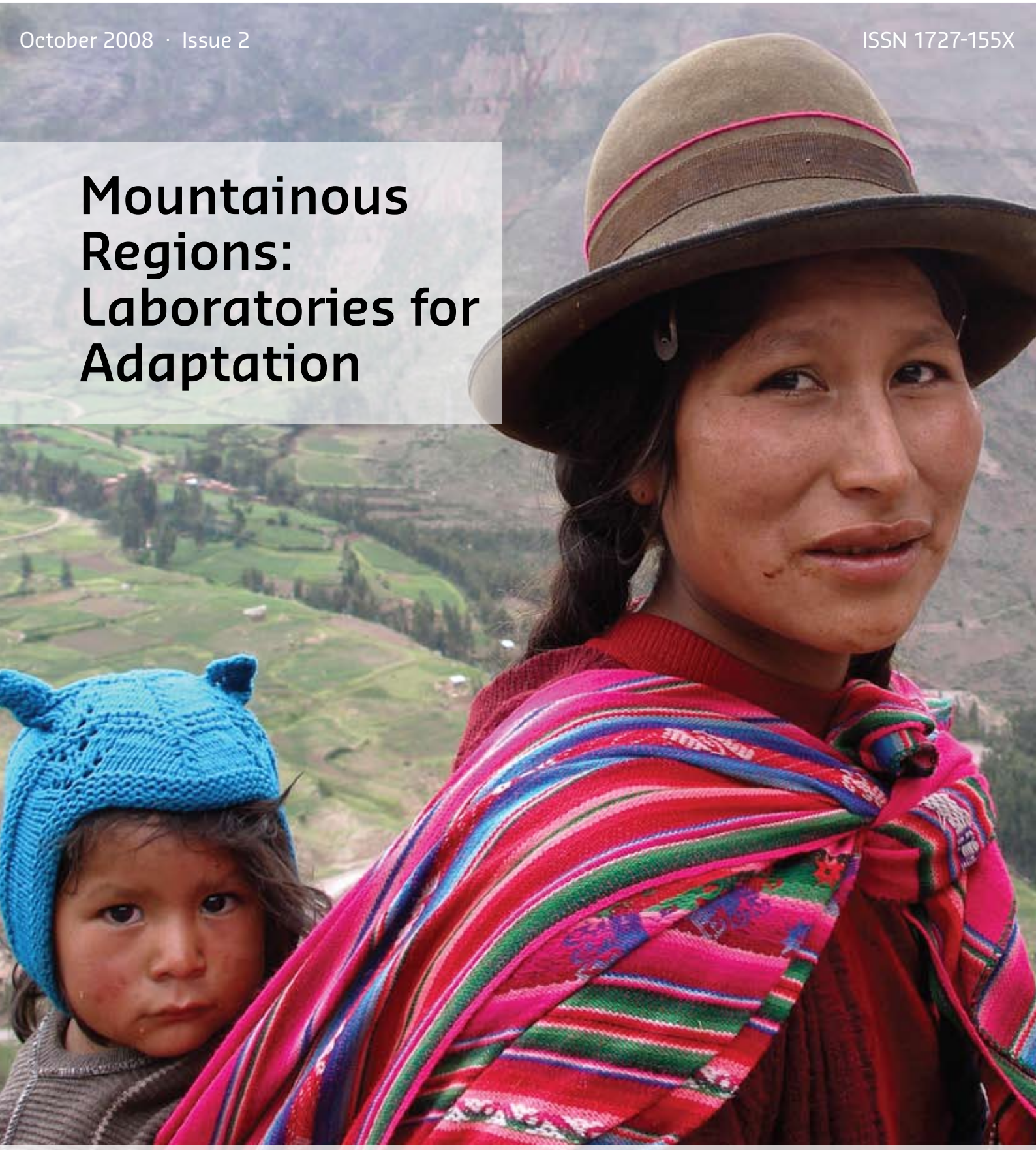
Mountainous Regions: Laboratories for Adaptation



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Cover photo: Thom Quine, *A woman with her child in the Peruvian Andes*

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Elma Montaña

Mendoza, a modern hydraulic society

In Andes of central western Argentina, the Mendoza River follows a quite spread out path. It originates in the snow-crested mountain range and flows toward the lower plains, providing water for the irrigation of oases developed on the foothills. This scheme develops in two opposing landscapes: on the one hand lies a green oasis with neat rows of grapevines, tree-bordered roads and streets, and irrigation channels and drains. This is the powerful oasis where human work celebrates having conquered a hostile nature. On the other hand, non-irrigated lands are a "no-man's land" and subordinate spaces perceived as empty and void of interest. Whereas the oasis concentrates the dynamism of Mendoza city's one million inhabitants and export viticulture-based economy, the scattered population of unirrigated lands barely survives on out-of-market economic activities, devastated by poverty and desertification processes (MONTAÑA ET AL., 2005).

Under this light, Mendoza River basin communities could be considered modern hydraulic societies, in which the social tissue is strongly associated with a comprehensive and intensive water resource manipulation within an order imposed to control a hostile environment (WORSTER, 1985:7). As power distributions are associated with water management, water would have the capacity to express, and also model, the hegemonic and subordinate social relations of a hierarchical system.

As links between water and community are very strong in the Mendoza River basin, scenarios in which climate change and water scarcity will intensify could cause not only spatial changes, but also affect social processes while influencing the existing relationships between nature and culture.

Water, climate and its scenarios

As in other dry lands, in the Mendoza River basin, water is a limiting factor for human settlement and agriculture. The intensive viticulture and horticulture of the area are only possible if tied to water management, making use of surface water distributed by the irrigation network or by pumping groundwater. Climate, however, also imposes it conditions, as frost and hail cause crop losses annually.

The Global Environmental Change (GEC) scenarios (2020-2030) built for the Mendoza River basin (BONINSEGNA AND VILLALBA, 2007) forecast a rise of 1.5°C in mean temperature, a decline of over 100mm in precipitation and a 150m rise of the 0°C isotherm, reducing the snow pack and increasing ablation surfaces. As a result of these changes, the flow volume of the Mendoza River is expected to dimin-

Harvesting tomatoes (Figure 3, opposite page) and grapes (Figure 4, above) on a horticultural farm in the Northern Mendoza; copyright Elma Montaña.

ish between 7 and 13%. The hydrogram of this nival regime river would also be affected. The peak discharge would be advanced by one month, increasing spring flows (October and November) and lowering summer outflows (January, February and March). This poses threats to agricultural and livestock activities already restricted by water scarcity, affecting not only farmers, but also the entire agricultural-based regional economy.

Farmers facing global environmental change

The research has focussed on the situations to be faced by farmers in three representative productive systems of the basin. Two of these systems consist of agricultural activities developed within the oasis irrigation system: one permanent (viticulture) and the other annual (horticulture, mostly olericulture). The third, goat husbandry, is an extensive livestock activity taking place mainly for subsistence purposes in non-irrigated areas upstream and especially at the tail of the basin.

Research has advanced in terms of exposure analysis while adaptive capacities are still under study. Nevertheless, some insights about the farmers' vulnerabilities can be anticipated. These can be illustrated by four main points:

a) Nature of the productive system: Oasis agriculture vs. non-irrigated extensive goat husbandry

A preliminary analysis must differentiate the agricultural systems (viticulture and horticulture) relying on irrigation from the goat husbandry extensively developed in non-irrigated zones. Diminishing precipitation will not affect the former but will decrease the natural vegetation of the desert, affecting goat husbandry and intensifying the desertification processes already in place. Drought periods strongly impact this activity, putting it at its survival limits and compromising alimentary security of its domestic production units. The extreme poverty of this area's population could raise a paradoxical situation in terms of vulnerability. The benefits of goat husbandry are so scarce that the incomes of these domestic production units must be complemented with others coming from temporary agricultural or urban activities and State subsidies. Therefore, these producers would need to become more diversified than those devoted exclusively to agriculture and would be more likely to adopt a wider range of adaptive strategies. Leaving theoretical arguments aside, their extreme poverty is closely related to their vulnerability.

The diminishing river runoff will be harder on agricultural farmers who rely on the surface irrigation network. In the context of a system that allocates water proportionally to the plot surface independent of whether the land is

being used and the crop type grown, viticulture farmers will be favored over horticulture producers because of the vineyards' lower water consumption and higher resistance to water stress. On the other hand, the annual cycle of horticulture makes adaptive strategies such as moving to better locations easier in terms of climate and water risks.

Agricultural farmers will see adaptation to hydrogram alterations facilitated by the operation of the Potrerillos dam, position just before the river reaches the oasis. Ecological flows are not being considered in the dam operation though, so the river regulation favoring water consumption in the oasis prevents water surpluses from reaching the tail of the basin. It is in this area that desert communities receive less and less water as the rural and urban oasis upstream continues its development. This subordinate position in the hydraulic society explains a good deal of the vulnerabilities of the desert communities.

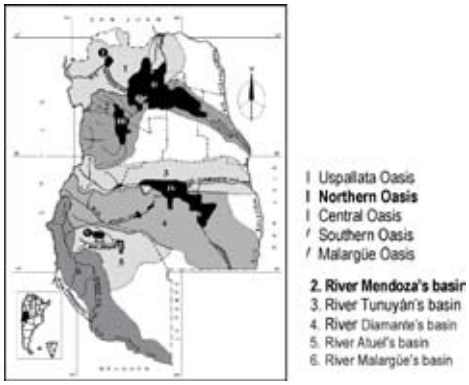

Figure 1: Mendoza Province, basins and irrigation oases, Source: Garduño, 2003

Figure 2: Northern Mendoza Oasis, Source: Proyecto PNUD-FAO/ ARG/00/008, 2006.

b) Structure of the productive chain and the farmers' position in it

Mendoza's river basin horticulture is an atomised agricultural sector formed by a great number of heterogeneous producers. The distribution channels are also varied in the context of a weakly regulated sector in which the informal economy plays an important part. The complicated and unstable decision making processes with which horticultural farmers must deal does not encourage investments that would reduce exposure. This structure will also set hurdles to the implementation of institutional measures that would help the most disadvantaged producers to face GEC scenarios.

In contrast, viticulture shows a clear structure with horizontal and vertical integration, as well as regulations set by formal institutional arrangements. Adaptive measures could be fostered here not only from the State but also by the existent farmers' organisations. As integrated and organised as this structure is, the farmers universe is quite polarised between the producers who make wine and are directly involved in the wine export circuit and small and medium scale farmers whose participation in the chain highlights their subordinate position. Are State institutions likely to be co-opted by the most powerful agents? This takes us to another issue.

c) Farmer typology

Faamer typology ("large/small", "capital intensive/traditional", "export/domestic" or any other showing power quotas) is directly related to vulnerability, in goat husbandry as well as in the oasis agricultural systems. The economic wealth of big farmers allows them to overcome reduced surface water allocation by pumping groundwater. In the context of loosely regulated groundwater management, they can even become independent from the "democratic" but tedious water users' organisation mechanisms and just turn on the pump whenever it fits their irrigational needs, obtaining water volumes only restricted by affordable and subsidised energy prices. In the same way, these farmers are in a better position to adopt other vulnerability reducing measures such as pressurised irrigation, which makes for a more efficient water use, or hail net protection. Unlike the more disadvantaged farmers, they can move to better locations, an adaptive strategy that is currently being seen not only with horticulture farmers that rent the land for their annual crops but also with big winemakers who buy land and build wineries in upstream foothill locations.

d) Location in the basin

Finally, the position in the basin appears to be a vulnerability factor. More successful agricultural farmers, especially

Figure 5: The facilities of a "seat" of a non-irrigated area. In the background, the natural vegetation; copyright Elma Montaña.

those integrated with the export sector, gradually climb the foothills to settle in the upper oasis lands, looking for lower temperatures, better standards of water rights that are less likely to be cut back in a drought situation as well as better water quality and less pollution. In some cases, such farmers push the agricultural border upstream by means of groundwater pumping. These are capital-intensive properties relatively protected from climate and water risks. On the other hand, those farmers who cannot afford such prime locations must resign themselves to the less attractive traditional locations of the oasis, leaving them with fewer resources to reduce their exposure and work out adaptive strategies. These farmers will be in greater need of institutional support to cope with the expected effects of GEC.

Conclusions

It is obvious that the vulnerability of Mendoza River basin farmers depends upon the nature of their activities, as some of them are more water and climate sensitive to GEC scenarios than others. Preliminary research findings show that even within the same productive system, other factors also affect a farmer's vulnerability, in terms of exposure as well as adaptive capacity. Some of these factors seem to be related to power relationships and to equity issues of this hydraulic society. Being wealthy and successful in the wine and food markets, having access to technology such as irrigation, being vertically and horizontally integrated and being privileged by the use of better and more expensive lands upstream are all shielding factors and indicators of a broader availability of adaptive resources.

Factors and mechanisms that could make farmers more or less vulnerable in GEC scenarios have shown a significant similarity to those which explain the performance seen while facing the challenges of the globalised agrifood markets during the 90s. At that time, the weakest producers, those who couldn't keep pace with the new rules of the game, were negatively affected or even thrown out of business, while a concentration process took place in favour of the more powerful agents. It seems that GEC effects will impact Mendoza River basin farmers in an analogous way, this time adding its effects to the ones already produced by globalisation.

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