Restoring Andean Landscapes to Secure Local Environmental Services and Global Benefits

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CONDESAN
Consortium for the Sustainable Development of the Andean Ecoregion

Effective landscape restoration practices require scientific knowledge about ecosystem functions, land use history, and institutional arrangements. In close collaboration with local partners, the Consortium for the Sustainable Development of the Andean Ecoregion (CONDESAN) is working to develop and assess restoration practices in Andean ecosystems. The approach combines various tools at the landscape scale, emphasizing the need to integrate restoration actions into land use planning and the importance of monitoring restoration practices. The sustainability of restoration practices remains a challenge, but the work underway will allow CONDESAN to generate sound alternatives for Andean landscapes.

Knowledge gaps hamper restoration efforts

Tropical montane forests and high Andean grasslands are 2 of the most biodiverse ecosystems worldwide. Despite their limited area compared with the Amazonian lowlands, tropical Andean ecosystems provide fundamental environmental services on local, national, and global scales, the most important services being biodiversity conservation, carbon storage, and water supply for cities, agriculture, and hydropower (Buytaert et al 2011). Although tropical Andean landscapes are highly relevant to sustainable development in the Andean countries, large areas are converted every year to serve agricultural uses, urbanization, and, more recently, mining. This has increasingly given rise to concerns about the loss of biodiversity and disruptions of the environmental services that these ecosystems provide. In response, international cooperation and governments are increasingly encouraging restoration practices in degraded tropical landscapes and have set ambitious goals, such as the restoration of 20 million hectares of Latin American tropical landscapes by 2020. However, there is still a long way to go to link the global agenda with local processes. Persisting knowledge gaps continue to hamper the implementation of sustainable land management practices, including restoration. For example, it is still poorly understood how tropical Andean ecosystems function, how different land use practices affect their functioning, and, most importantly, how they respond to different restoration practices.

CONDESAN's approach to landscape restoration

In order to take full advantage of the opportunity offered by these new initiatives, the Consortium for the Sustainable Development of the Andean Ecoregion (CONDESAN) conceives of restoration as a tool, taking into account the following aspects:

- Restoration is an integral component of land management, and as such, it is closely linked to sustainable production systems. Restoration actions must therefore simultaneously take account of the benefits and needs of landowners, the development agenda of the local government, and the interests of environmental agencies. Institutional arrangements are a key aspect in securing the long-term sustainability of restoration actions.
- A clearly articulated conceptual framework is urgently needed to provide a context for the restoration practices promoted. This must include clear and realistic goals that are linked to the desired characteristics of the ecosystems in question (Hobbs and Harris 2001). Defining goals is an essential element in designing restoration actions that are effectively oriented toward achieving the desired outcomes. In addition, the conceptual framework must reflect the dynamic nature of ecosystems. The resulting variability means that certain short- and long-term outcomes of restoration practices might not be adequately assessed by indicators that compare the current state of the ecosystem to a past state. Indicators for assessing restoration outcomes should therefore take the desired future characteristics of the ecosystems in question as the point of reference.
- Landscape restoration actions take place in a wide range of environmental and socioeconomic conditions. This requires the adoption of common standards to ensure that restoration actions are implemented in a consistent and comparable way. These standards can be defined by designing and applying a common methodological approach, and by developing protocols to guide the implementation and subsequent evaluation of the actions. Moreover, the use of common protocols and a set of common tools will also ensure the comparability of restoration actions and their transferability from one ecosystem to another.
- Restoration actions must be monitored and evaluated as part of a continuous learning process on how the given ecosystems function and how they respond to restoration practices. The adoption of a common monitoring protocol containing criteria and indicators that were standardized by leading

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scientists as well as validated by local practitioners is essential for ensuring cross-compliance with multiple restoration goals and objectives (PACTO 2013). Monitoring is key in assessing the accomplishments of a restoration process, starting with the evaluation of the methods used and continuing with subsequent assessments of whether the restoration site is following a desired pathway. In addition, monitoring provides an opportunity to search for and appraise sensitive indicators. Such indicators are fundamental in monitoring dynamic processes in terrestrial ecosystems, such as restoration of environmental services, carbon sequestration, and biodiversity preservation.

Evaluating restoration practices in Ecuador and Peru

Taking into account these considerations, CONDESAN, with the support of 2 regional initiatives—EcoAndes, a project funded by the Global Environment Facility through the United Nations Environment Programme, and the Andean Forest Program, funded by the Swiss Agency for Development and Cooperation—and in close collaboration with local nongovernmental partners—Fundación Imaymana, Nature and Culture International Peru, and Fondo de Páramos de Tungurahua—is helping to restore around 5000 hectares of montane forest and 2000 hectares of alpine grasslands (*páramos* and *punas*) in 5 Andean landscapes of Ecuador and Peru. To support the implementation of these actions, 10 experimental studies have been set up to assess the effectiveness of different restoration practices. The studies cover forest and non-forest ecosystems with different objectives and land use histories. A first group of experiments is aimed at restoring habitat structure to improve remnant forest patches and ecosystem productivity, as well as soil physical conditions and vegetation cover to increase water infiltration and water regulation capacity. The second group of experiments focuses on recovering heavily degraded pasturelands by establishing complex agroforestry systems using analog forestry as the main approach. In analog forestry, the forest's structure and its functioning with regard to service delivery are considered critical in establishing socioeconomically productive landscapes with a high biodiversity to biomass ratio (Dickinson 2014).

Generating knowledge for national restoration programs

The various experiments will be monitored during 2 consecutive years using a common set of sensitive ecological and socioeconomic indicators. By measuring indicators linked to productivity (carbon sequestration), plant community structure and composition, and key soil properties, we will be able to generate critical knowledge about how the restoration practices affect the ecosystems.

The knowledge generated through these actions will be disseminated and incorporated in the national restoration programs that both countries are currently promoting. In Peru, the knowledge will feed into the National Program for the Recovery of Degraded Areas implemented by the National Forestry Service of the Ministry of Agriculture and Irrigation. In Ecuador, the knowledge will inform the National Forest Restoration Program of the Ministry of Environment.

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