The new wave of hydroelectric dams in the Andes: How sustainable?

Vicente Tinoco*, G.Mathias Kondolf

Dept. of Landscape Architecture and Environmental Planning, University of California, Berkeley, USA.
* PhD student

Presented to the annual meeting of the Council of Educators in Landscape Architecture, Beijing, May 2017

Dams provide numerous benefits to societies, such as municipal, industrial, and agricultural water supply, hydroelectric power generation, and reduction in flood magnitudes downstream. However, dams have many negative impacts, including flooding out river valleys and loss of cultural, economic, social, and environmental values therein, creating still-water reservoirs that often suffer water quality problems, blocking fish migration, and altering flow patterns downstream. Moreover, dams trap sediment, which affects both the reservoir sustainability (by impairing dam functions, reducing storage capacity, increasing risk of dam failure) and negatively impacts the geomorphology and ecology of downstream reaches (Kondolf et al. 2014). In the Amazon River tributaries of Colombia, Bolivia, Ecuador and Peru, at least 151 new hydroelectric dams >2MW are planned over the next 20 years, increasing hydropower capacity by 300% (not including dams in the Brazilian lowlands) (Finer & Jenkins 2012, Zarfl et al. 2015)). Despite the scale of this development, no comprehensive cumulative impact analysis has been undertaken to date, nor any attempt to analyze potential distribution of dams within the drainage network to optimize power production while minimizing environmental impacts. The high sediment loads of these steep Andean tributaries makes sediment problems likely, and they are already evident in at least two projects in Ecuador. Many of the new dams are being designed and built by foreign investors. Typical contracts require investors to design and construct the projects, collect most of the power revenues during the first 20-30 years of project operation, then turn the projects over to the host countries. If the dams have substantially filled with sediment by then, the projects may be more burden than benefit to the host countries. However, reservoir sedimentation problems need not be inevitable, as there are multiple approaches to pass sediment through or around dams that can work in many contexts (Kondolf et al. 2014). Such measures are best developed and implemented in the initial design stage, as retrofits tend to be more costly, less effective, and riskier. We systematically reviewed available information for planned hydropower projects in Ecuador (ARCE 2015) in the context of river basin sediment yields to assess the degree to which dam design and proposed project operation incorporate strategies to pass sediment downstream or otherwise account for incoming sediment in a sustainable manner. Based on this analysis, and drawing upon experience elsewhere employing sustainable sediment management approaches, we recommend priority actions to improve the sustainability of future reservoirs in the Andes and to minimize their downstream impacts.

References

ARCE (Agencia de Regulación y Control de Electricidad) (2015) *Inventario de Recursos Energéticos del Ecuador con Fines de Generación Eléctrica* 2015 (Quito, Ecuador).

Finer M, Jenkins CN (2012) Proliferation of Hydroelectric Dams in the Andean Amazon and Implications for Andes-Amazon Connectivity. *PLoS ONE* 7(4):e35126

Kondolf, GM, Gao, Y, Annandale, G, Morris, G, Jiang, E, Zhang, J, Cao, Y, Carling, P, Fu, K, Guo, Q, Hotchkiss, R, Peteuil, C, Sumi, T, Wang, H-W, Wang, Z, Wei, Z, Wu, B, Wu, C, Yang, CT (2014). Sustainable sediment management in reservoirs and regulated rivers: Experiences from five continents. *Earth's Future* 2 (5), 256–280.

Zarfl, C., Lumsdon, A., Berlekamp, J., Tydecks , L., and Tockner K. (2015), A global boom in hydropower dam construction. *Aquatic Sciences* 77 (1), 161–170.