Co-production of knowledge on water scarcity risks using Impact Chains: Insights for Regenerating Mountain Watersheds

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Abstract

Water scarcity is a growing challenge in mountain regions, where climatic variability, land degradation, and aging infrastructure interact with social and institutional vulnerabilities. The Greater Asmara Area in Eritrea exemplifies these issues, with its plateau topography and densely populated settlements facing watershed degradation and water insecurity. Addressing such risks is vital not only for urban resilience but also for the regeneration of mountain villages, where water management is deeply linked to the preservation of nature, culture, and heritage.

This study applied a two-component methodology: (1) co-producing an Impact Chain for urban water scarcity risk through desktop analysis and a multi-stakeholder workshop; and (2) evaluating the co-production process using criteria of scientific credibility, policy salience, and procedural legitimacy. The participatory approach enabled diverse knowledge holders—including local communities—to collaboratively map cascading impacts and vulnerabilities across watershed, infrastructure, and user levels, integrating context-specific insights related to micro-dams, informal water access, and gendered household burdens.

Results show that drought and extreme rainfall hazards trigger major impacts—reduced water availability, soil erosion, infrastructure stress, and local contamination—amplified by structural vulnerabilities such as degraded catchments and uneven access. These findings underscore the value of co-production and boundary work in developing locally grounded, systemic representations of water scarcity risks. By bridging scientific and local knowledge, the study supports more informed and actionable pathways for water security planning, contributing to the sustainable regeneration of mountain villages and the preservation of their natural and cultural landscapes.

Keywords: Impact Chains; Urban water management; Climate resilience; Knowledge co-production; Watershed degradation; Infrastructure vulnerability; Mountain regions; Eritrea