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RESOURCE CATALOG

Natural Infrastructure for
Water Security Project
Peru



October 2023



Photo: Denis Justo Mayhua Coaquira





The Natural Infrastructure for Water Security project (NIWS) was designed to scale-up investments in natural infrastructure for water security in Peru – and has developed the most ambitious portfolio of investment in nature-based solutions for water security and climate resilience in the Latin American region. Currently, NIWS is managing a portfolio of 80 projects valued at USD 440 million, developed with 18 institutions and over 240 communities and local populations.

To achieve this portfolio, NIWS has worked to strengthen information, tools, and implementation mechanisms needed to scale effective, equitable investments in natural infrastructure for water security. This catalog shares key resources available to the public that we have developed under NIWS to support these efforts, organized in the following six sections:

1. The State of Knowledge on Natural Infrastructure for Water Security in the Andes
2. The State of Finance for Natural Infrastructure for Water Security in Peru
3. Identifying Opportunities to Invest in Nature-Based Solutions
4. Designing Quality Interventions
5. Estimating Hydrological Benefits
6. Improving Implementation Mechanisms



THE STATE OF KNOWLEDGE ON NATURAL INFRASTRUCTURE FOR WATER SECURITY IN THE ANDES

NIWS has improved the knowledge base supporting natural infrastructure interventions, providing stakeholders with research-based evidence to make better decisions. Our systematic reviews of the literature and original research have increased clarity and credibility regarding the water benefits of natural infrastructure interventions, answering questions like: **How do ecosystems contribute to water security in the Andean context? What impacts do human interventions on the landscape have on the water cycle? How can we use natural infrastructure to manage disaster risks like floods and landslides?**



WATERSHED SERVICES OF HIGH ANDEAN GRASSLANDS: WHAT DO WE KNOW?

By G. Mosquera, F. Marín, M. Stern, *et al.*



A systematic review of 38 studies on the hydrological functions of high Andean grasslands, as well as the impacts of land use change and restoration practices. The review also identifies knowledge gaps.

Related article published in *Science of the Total Environment*:



Progress in understanding the hydrology of high-elevation Andean grasslands under changing land use



IMPACTS OF LAND USE CHANGE ON HYDROLOGY IN THE ANDES

By B.F. Ochoa-Tocachi, W. Buytaert, B. De Bièvre, *et al.*



This study presents data on the impact of human interventions (e.g. cultivation, afforestation, grazing) in high-Andean grassland ecosystems on hydrological processes gathered from a participatory monitoring network of 25 watersheds in the region.



IMPACTS OF ANDENES AND TERRACES ON WATER AND SOIL: WHAT DO WE KNOW?

By B. Willems, W. Leyva-Molina, R. Taboada-Hermoza, *et al.*



A systematic review of the impacts of terraces as ancestral and community practices of water and soil conservation on watersheds services in Peru. The review includes 26 studies relevant to measuring and analyzing water infiltration, surface runoff, soil moisture conservation, base flow, peak flow control, and water yield.



NATURAL INFRASTRUCTURE FOR THE MANAGEMENT OF EROSION AND FLOOD RISKS IN THE ANDES: WHAT DO WE KNOW?

By A. Molina, V. Vanacker, M. Rosas Barturen, *et al.*



A systematic review of the impacts of natural infrastructure interventions on erosion, landslides and flooding in the Andean region. The review includes more than 137 local case studies that quantify the effect of implementing natural infrastructure for mitigating the aforementioned risks.

Related Journal article published in SOIL:



The effect of natural infrastructure on water erosion mitigation in the Andes



IMPACTS OF INFILTRATION TRENCHES ON WATER AND SOIL: WHAT DO WE KNOW?

By B. Locatelli, J. Homberger, B.F. Ochoa-Tocachi, *et al.*



A systematic review of the impacts of infiltration trenches on water ecosystem services, particularly on water and soils in mountainous areas. Infiltration trenches are designed to intercept, collect, and infiltrate surface water runoff. The review includes 57 journal articles in 12 countries, covering a total of 80 different sites.



POTENTIAL CONTRIBUTIONS OF PRE-INCA WATER INFILTRATION INFRASTRUCTURE FOR WATER SECURITY IN THE ANDES

By B.F. Ochoa-Tocachi, J.D. Bardales, J. Antiporta, *et al.*



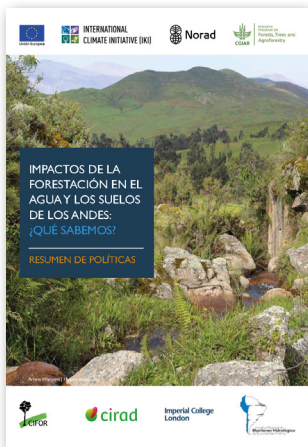
In the tropical Andes, pre-Inca cultures developed nature-based water harvesting technologies to manage drought risks under natural climatic extremes. This study shows how integrating these ancestral practices can safeguard water security in Lima and provide a critical complement to conventional engineering solutions.



Journal article published in Nature Sustainability:



Potential contributions of pre-Inca infiltration infrastructure to Andean water security



IMPACTS OF FORESTATION ON WATER AND SOILS IN THE ANDES: WHAT DO WE KNOW?

By V. Bonnesoeur, V. Locatelli, and B. Ochoa-Tocachi.

ESP >|

A systematic review of the impacts of forestation on water supply, hydrological regulation and mitigation of erosion and landslides evaluated from 155 studies. The study compares the hydrological processes of infiltration, evapotranspiration and runoff in forest plantations of exotic species in high Andean grassland ecosystems with hydrological services from natural patches of native forests.

ENG (Brief) >|

Related journal article published in *Forest Ecology and Management*:

ENG >|

Impacts of forests and forestation on hydrological services in the Andes: A systematic review.

Other articles published in academic journals:

ENG >|

Ecohydrology and ecosystem services of natural and artificial bofedales wetlands in the central Andes by M. Monge-Salazara, C. Tovar, J. Cuadros-Adriazola, et al; Published in *Science of the Total Environment*.



THE STATE OF FINANCE FOR NATURAL INFRASTRUCTURE FOR WATER SECURITY IN PERU

Investment in natural infrastructure for water security in Peru has grown steadily over the last 14 years. Understanding these trends is critical to seeing new opportunities and needs for scaling-up. These reports document trends in investment in natural infrastructure for water security in Peru, and answers questions like: **How much is being invested in natural infrastructure for water security in the country? Who is investing? Where are they spending? What actions are they financing? What is the regulatory framework that allowed these investments to take place? What are the current challenges and opportunities?**



OPENING THE TAP: STATE OF FINANCE FOR NATURAL INFRASTRUCTURE FOR WATER SECURITY IN PERU, 2021

ENG >|

Peruvian policymakers and water managers are increasingly recognizing the role natural infrastructure and ancestral technology play in managing water risks. This report shows how financing for natural infrastructure for water security in Peru has grown by a factor of 13 between 2014 and 2020, reaching the equivalent of USD 10.2 million executed in 2020.

ESP >|



RECOVERING LIQUIDITY: STATE OF INVESTMENTS IN NATURAL INFRASTRUCTURE FOR WATER SECURITY IN PERU, 2022

ESP >|

This study shows how the investment executed in 2021 increased by 42% compared to 2020. Despite the complex context caused by the pandemic, there is a significant fluidity in the recovery of investment and, in addition, the figures prior to the health crisis were surpassed.



IDENTIFYING OPPORTUNITIES TO INVEST IN NATURE-BASED SOLUTIONS

NIWS has also developed tools to support the design and implementation of natural infrastructure projects. Our HIRO tool helps to answer questions like: **Where should I locate a natural infrastructure intervention? What areas will address a given water risk most effectively? What is the most appropriate intervention for a specific area?**



HIRO: RAPID IDENTIFICATION TOOL FOR OPPORTUNITIES IN NATURAL INFRASTRUCTURE

HIRO is an innovative GIS tool developed by NIWS that uses official information from different sectors to quickly identify critical areas for NI interventions to address priority water risks within a specific area. Based on this geographic targeting, the tool also provides recommendations for the most appropriate natural infrastructure interventions. The various adaptations of HIRO are listed below:



HIRO for Disaster Risk Management User Guide (DRM)

This document guides users to implement the HIRO methodology using GIS, specifically to identify priority areas for disaster risk management.



HIRO-Ambiente Platform for DRM

The Peruvian Ministry of Environment implemented this online geographical viewing platform, based on an adaptation of the HIRO for DRM methodology.



DESIGNING QUALITY INTERVENTIONS

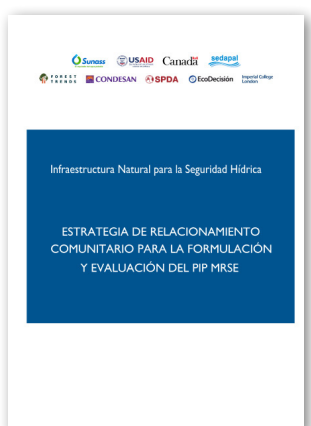
In addition to improving the technical basis for natural infrastructure, NIWS has prepared guidance to ensure interventions are effective, equitable, and sustainable. The following resources help answer questions like: **How can we design equitable interventions? How can we improve the sustainability of an intervention? How should we evaluate success? How can we engage communities in the process?**



GUIDE FOR THE EVALUATION OF INTERVENTIONS IN NATURAL INFRASTRUCTURE FOR WATER SECURITY: EFFECTIVENESS, EQUITY AND SUSTAINABILITY (EES) SCALE



This guide presents a scale for evaluating natural infrastructure projects across three dimensions: effectiveness, equity and sustainability. The guide helps project developers identify opportunities and specific actions to improve the quality of natural infrastructure projects throughout the project development cycle, in a spirit of continuous improvement and learning.



COMMUNITY RELATIONS STRATEGY FOR THE FORMULATION AND EVALUATION OF PUBLIC INVESTMENT PROJECTS UNDER PERU'S COMPENSATION MECHANISMS FOR ECOSYSTEM SERVICES (MERESE) PROGRAM



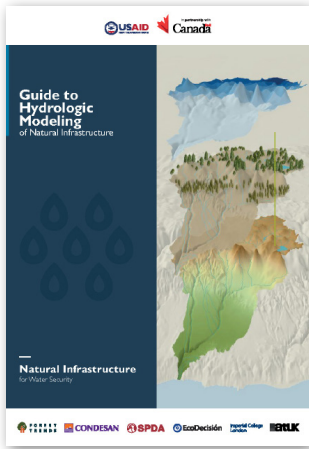
This strategy establishes a roadmap for community relations regarding the formulation and evaluation of payment for ecosystem services projects between Lima's water utility (SEDAPAL) and the communities within its watersheds. The strategy highlights two transversal axes:

1. Effective communication channels and
2. Capacity building for community members.



ESTIMATING HYDROLOGICAL BENEFITS

NIWS has also developed technical guides for estimating benefits of nature-based solutions, which help to answer questions like: **How can I estimate the water benefits of a natural infrastructure intervention? How do I choose between proposed natural infrastructure alternatives? How can hydrologic modeling help me answer these questions? Which model should I use?**



GUIDE TO HYDROLOGIC MODELING OF NATURAL INFRASTRUCTURE



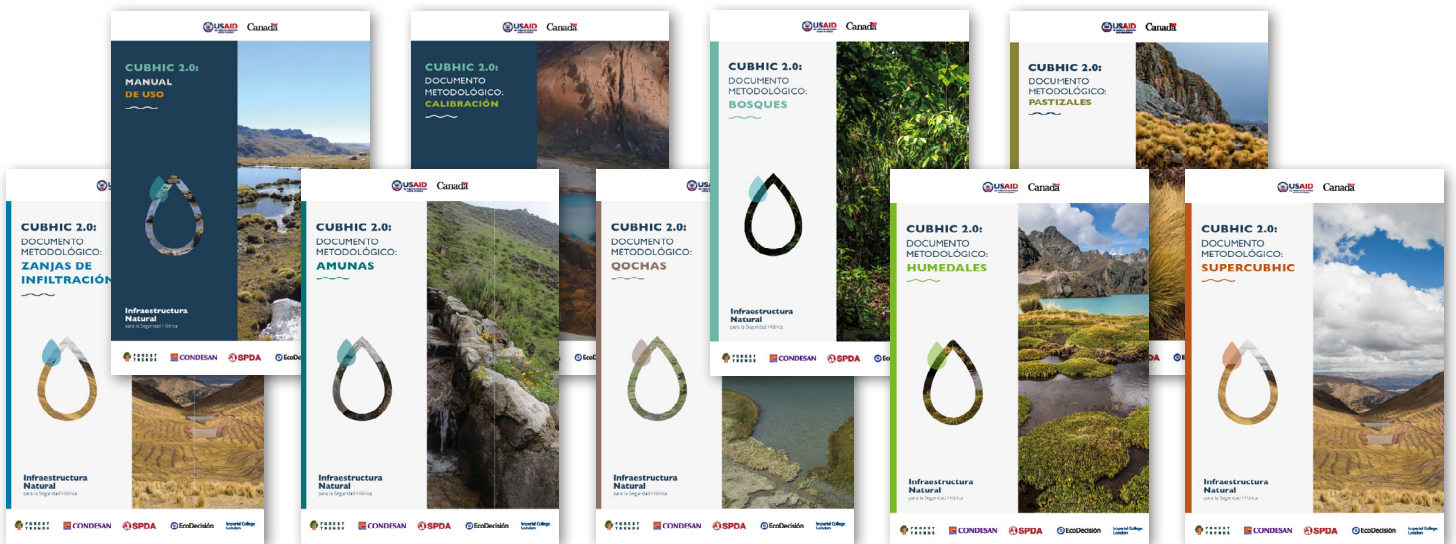
This guide provides criteria for the selection and use of hydrological models aimed at quantifying the expected benefits of natural infrastructure projects. It creates a bridge between decision makers and technical specialists in order to generate relevant results for water resources management. The guide is divided into two volumes: the first is aimed at selecting appropriate hydrological models for the policy questions at hand, and the second provides guidelines for hydrological modeling.



CUBHIC 2.0: METHODOLOGIES FOR THE QUANTIFICATION OF HYDROLOGICAL BENEFITS OF WATERSHED INTERVENTIONS



The CUBHIC toolbox responds to a critical need for the rapid, ex-ante quantification of expected hydrological benefits of a natural infrastructure intervention. The methodologies use local data such as precipitation, temperature, and characteristics of soil, land cover, and natural infrastructure interventions to estimate the benefits of the most common interventions such as infiltration ditches, forest conservation and reforestation, permeable micro-reservoirs (qochas), wetland restoration, grassland management, and ancestral infiltration canals (amunas).



Other articles published in academic journals:



Producing valuable information from hydrologic models of nature-based solutions for water by K.Brauman, L.Bremer, P. Hamel, et al; Published in Integrated Environmental Assessment and Management.



PISCOeo_pm, a reference evapotranspiration gridded database based on FAO Penman-Monteith in Peru by A.Huerta, V.Bonnesoeur, J.Cuadros-Adriazola, et al; Published in Scientific Data.



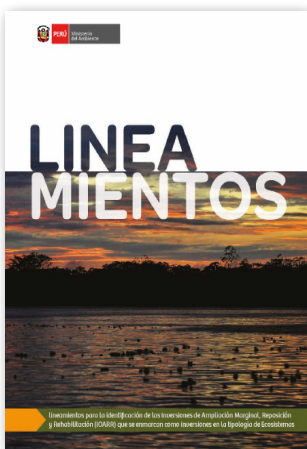
IMPROVING IMPLEMENTATION MECHANISMS



MANUAL FOR THE FORMULATION AND EVALUATION OF INVESTMENT PROJECTS IN NATURAL INFRASTRUCTURE



This manual provides guidance for water utilities developing projects in the framework of Peru's Compensation Mechanisms for Water Ecosystem Services (MERESE). It outlines each step of project development, offering a clear process to avoid and address common bottlenecks, and helps utilities consider socio-economic aspects of project design from the beginning.



GUIDELINES FOR THE IDENTIFICATION OF INVESTMENTS IN OPTIMIZATION, MARGINAL, EXPANSION, REPLACEMENT AND REHABILITATION (IOARR) FOR ECOSYSTEMS



This document provides guidelines for applying IOARR – a mechanism under the Peruvian Public Investment system that traditionally allows for streamlined investment to repair or maintain gray infrastructure – to projects that aim to restore and conserve ecosystems, or natural infrastructure. The guidelines include the regulatory framework, key definitions, a list of strategic assets to be considered criteria for applying IOARR, and case studies.

www.infraestructuranatural.pe

About the Natural Infrastructure for Water Security Project (NIWS)

NIWS works to scale-up investments in the conservation, restoration and sustainable use of ecosystems and ancestral technologies, in order to reduce water risks, such as droughts, floods and water pollution in Peru. To achieve this objective, NIWS works to improve the enabling conditions for scaling natural water infrastructure approaches, improve the information generated and used for decisions on natural water infrastructure, and develop, secure financing, and facilitate implementation of natural infrastructure projects. Throughout these components, NIWS works to reduce gender inequalities in water resource management and natural infrastructure solutions.

NIWS is funded and supported by the United States Agency for International Development (USAID) and the Canadian Government. It is implemented by a consortium led by Forest Trends, with local partners the Consortium for the Sustainable Development of the Andean Ecoregion (CONDESAN) and the Peruvian Society for Environmental Law (SPDA), international experts from EcoDecisión, and researchers from Imperial College London.

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