Targeted Habitat Protection

INTERVENTION CATEGORY: PROTECTION

DESCRIPTION

Targeted protection of habitats refers to all conservation activities undertaken to protect targeted ecosystems, such as forests, grasslands, or wetlands.[1] It is typically implemented as a preventative measure, aiming to reduce the risk of future adverse environmental impacts that may result from land use and water use changes.[2] In particular, this NbS-WS seeks to prevent increased sediment or nutrient loadings, or disturbance of the hydrological cycle.

Several activities can be considered under this NbS. General protection mechanisms can be categorized as legislation, administrative designations, regulations, acquisition of enforceable rights in natural resources, and judicial actions.[3] Examples of concrete activities include designating new protected areas, conservation easements, land rental and increased enforcement of existing protected lands. Conservation easements can be effective for the permanent conservation of private lands. A conservation easement is a restriction placed on a piece of property to protect its associated resources and is either voluntarily donated or sold by the landowner.[4] Land may also be rented from private owners in order to achieve conservation objectives. Where land has already been designated for protection purposes, additional staff may be employed to provide educational programs, outreach to communities, and enforcement of conservation regulations.

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WATER SECURITY CHALLENGES (WSCs) ADDRESSED

TYPE		IMPACT	MAGNITUTE	DEPTH OF EVIDENCE BASE
Water availability	Groundwater recharge	Increased mean annual groundwater recharge	★★☆	★★☆
	Dry season flows	Maintained dry season flows	★★☆	★★☆
Disaster risk	Flood risk	Reduced peak discharge	★★★	★★★
Water quality	Erosion and sedimentation	Reduced on-site erosion and sediment yields	★★★	★★★
	Nutrients and pollutants	Reduced in-stream nutrient and pollutant concentrations	★★★	★★☆

Due to the preventative nature of this NbS-WS, benefits can only be evaluated by analyzing realistic scenarios of potential future land use changes, and assess negative impacts avoided by the presence of the protection. The nature of the benefits depends, among others, on the type of protected ecosystem and the alternative scenario(s). In the case of upland forests, averted flood risk in downstream locations is an often reported benefit.[5, 6, 7]

A large knowledge base is also available with regards to linkages between targeted land protection and water quality. A review of studies and reports (primarily from the United States and New Zealand) demonstrates that that water quality generally begins to deteriorate when forest cover falls below 60–90% of catchment area, depending on context.[8] Among other benefits, maintenance of water quality is also regarded as an important effect of wetland conservation. Potential cost savings from avoided drinking water treatment operations and maintenance can be significant.[2] Conservation of wetlands can, however, have a certain tradeoff with flood risk; high water levels are generally required for biodiversity purposes but may conflict with storage needs for flood mitigation.[9] Targeted habitat protection is often very effective in limiting soil erosion and in-stream sediment loads, which can be especially beneficial in cases where downstream hydropower projects or water supply storage reservoirs are present.[10]

OTHER BENEFITS

WHAT?	HOW?
Biodiversity[11, 12]	Well-managed protected areas with enforced conservation regulations are effective in stopping land clearing, mitigating logging, hunting, fire, and grazing, thus preserving habitats and positively affecting both terrestrial and aquatic biodiversity.
Electricity generation[10]	In watersheds with downstream hydropower development, healthy upstream natural systems contribute to flow regulation and avoiding damage from sediment loads.
Carbon storage (avoided emission)[2]	Both above-ground and below-ground biomass losses are avoided by effective land protection.
Aesthetic quality/ recreation	Maintenance of intact natural ecosystems can also serve eco-tourism purposes and provide opportunities for recreation.
Job creation	Additional staff may be employed to provide educational programs, outreach to communities, and enforcement of conservation regulations.

LINKAGES TO CLIMATE CHANGE

Mitigation: Preservation of natural vegetated habitats such as forests, wetlands and grasslands contributes to sequestration of large amounts of carbon both above- and below-ground.

Adaptation: Protection of vegetated habitats mitigates hydrological extremes and provides a cooling effect through evapotranspiration.

DESIGN-ENABLING CONDITIONS AND TYPICAL CONSTRAINTS

- Identification of opportunities and priorities for land conservation to protect water sources depends on reliable information on species' locations, habitat requirements and threats, and information on where water security benefits can best be achieved.[1] For example, the relationship between forest cover and water quality is non-linear and complex. Factors such as location in the watershed, the mix of land uses in the watershed, past land use history, and climate change can all impact the amount of forest cover needed to sustain healthy waters.[8]
- Watershed size is an important variable in setting land protection objectives regarding downstream water quality. The smaller the drainage area, the easier it will be to accomplish measurable water quality objectives using conservation strategies. In the United States, water suppliers that choose land conservation as a primary strategy usually have drainage basins or aquifer recharge areas of 300,000 acres or less.[4]
- Effective land protection in larger watersheds is often concerned with a range of public and private stakeholders, and multiple political jurisdictions. Interests need to be aligned e.g. in public-private partnership arrangements, potentially offering significant water quality benefits over large scales.[4]
- Identification of future land use changes and threats can be guided by concrete local plans as well as longer-term growth trends and development patterns on different spatial scales.[4]
- Adequate incentives for cooperation among stakeholders for effective land protection is more likely to be achieved when other objectives such as livelihoods, recreation opportunities, and flood control are well acknowledged and accounted for in protection strategies.[4]
- Being a preventative measure, this NbS-WS is constrained by the available data on current water security benefits, as in non-degraded systems any negative impacts cannot yet be observed.
- Protected area effectiveness correlates with basic management activities such as enforcement, boundary demarcation, and direct compensation to local communities.11 Depending on context, it can be constrained by the availability of skilled staff to provide educational programs, outreach to communities, and enforce protection regulations.

RELATION TO GREY INFRASTRUCTURE

INFRASTRUCTURE?	SERVICE PROVIDED BY GREY SOLUTIONS
Water treatment plants (downstream)	Improvement of water quality for (domestic) purpose
Dams/reservoirs for hydropower (downstream)	Energy production

COMMON RISKS AND TRADE-OFFS

- In large watersheds spanning different administrative units, communities, and economic interests, many different stakeholders need to be on board for effective land protection. The risk of a partner dropping out from any agreement/arrangement made increases with size and diversity of the group of stakeholders involved. Opportunity costs need to be accounted for, especially when local communities are poor and have limited resilience.[13]

- Where the business case for targeted habitat protection involves recreational (eco-tourism) use of sections of the protected area, active management and enforcement should minimize the risk of anthropogenic disturbance.[12]
- The nature of this preventative NbS-WS comes with a general risk of "mispredicting" future land use changes and socio-economic processes driving them, thus developing protection mechanisms that may be less effective or missing certain areas in the prioritization process.
- Several of the world's most valuable ecosystems are located in politically unstable areas, posing risks to durable design and enforcement of protection mechanisms.[14]
- A tradeoff may occur between maintaining services of native ecosystems and human interests related to water use, e.g., when preserving seasonal streams (and species that adapted to that seasonality) or regularly flooded systems.

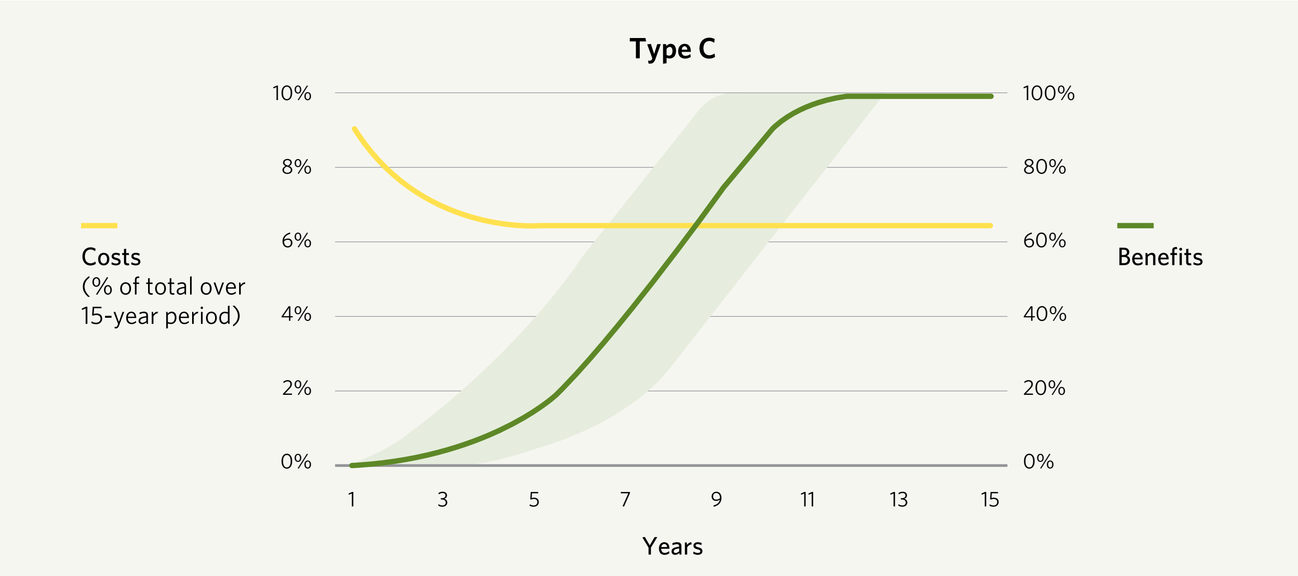
MONITORING OPPORTUNITIES

- Satellite remote sensing is well-suited for evaluating effectiveness of targeted habitat protection. Extent and condition of vegetated habitats can be evaluated across spatial scales.[15]
- (Eco-)hydrological simulation models are required for analyzing water security impacts of targeted habitat protection in relation to potential negative impacts of future land use change scenarios. Many tools can be deployed for spatial simulation of the relevant biophysical processes affecting water quality and quantity across watersheds, of which the SWAT and InVEST models are commonly implemented examples.[16,17] These tools require historical and current records of flows, sediments and water quality for calibration with respect to baseline conditions.

IMPLEMENTATION COSTS AND TIMING OF BENEFITS

Targeted habitat protection **costs** are mostly recurring, e.g., through land rental or labor costs that are relatively constant and incurred over time. Costs are highly variable across the world, as they depend on the local economic value of land and labor. In the case of conservation easements, capital costs are incurred related to initial assessment of site conditions, economic appraisal, and/or environmental impact assessment. For example, for private land owners in Colorado, U.S., total capital costs can amount to $61,500–$81,500 for a donated easement.[18]

Especially in watersheds with downstream cities and associated economic activity, the large number of potential beneficiaries can translate into comparatively modest per capita costs and a high cost-benefit ratio. For half of the world's cities, annual source water protection activity costs could be just US$2 or less per person per year.[2] In terms of economic **benefits**, targeted habitat protection is generally considered very effective as it is much less costly than reversal of any negative trends.[4]



Deforestation in the Amazon for cattle ranching (source: TNC).

EXAMPLES

Ruvu River, Tanzania[19]

Brief description: The SWAT biophysical model was linked to an economic valuation of the presence of forests and woodlands, focusing on the benefits provided by their ability to regulate the availability of drinking water in the major cities of Dar es Salaam and Morogoro.

Lessons learnt:

- Retaining the forest and woodlands can help avoid costly deterioration in the public water supply to the two cities. Estimated treatment cost savings due to forest conservation amount to USD 4.6–1 7.6 million per year for Dar es Salaam's population. An estimated additional cost saving of US$ 308,000 per year for maintenance of the Mindu Dam, which provides potable water to the population of Morogoro, can be realized by conservation of Ruvu's forests and woodlands.

- The poorest households are most affected by the failure to provide reliable tap water when the upland forests are not preserved, due to the price hikes that occur when water is rationed.

Pursat, Cambodia[10]

Brief description: A modelling framework was applied to the proposed Pursat 1 Dam to estimate payments for forest conservation. Future land use change projections and associated watershed erosion and reservoir sedimentation were quantified using a spatial simulation model and compared to a scenario in which all upstream forest is effectively preserved. Benefits of forest conservation were translated into averted power generation losses and used to inform the design of a proposed PES scheme.

Lessons learnt:

- Forest protection costs were estimated at US$ 0.9 $ha^{-1}yr^{-}$.[10] The estimated net present value of forest conservation was US$ 4.7 million–US$ 6.4 million depending on future climate conditions.
- A PES scheme with payments between US$ 4.26–US$ 5.78 $ha^{-1}yr^{-1}$ would be justified from the operator's perspective and would more than cover the required costs of forest conservation.

Sebago Watershed, Maine, United States[20]

Brief description: The Sebago Lake watershed provides drinking water to more than 200,000 users in the greater Portland, Maine region. The watershed contains abundant forests and cold water lakes and streams. The Portland Water District (PWD) invests in watershed protection through acquisitions and conservation easements in partnership with local and regional conservation organizations. The Sebago Lake watershed faces the threat of water quality impairment through loss of forest cover, primarily due to anticipated development. This study addressed the economic feasibility of scaling up investments in forest conservation that would secure water quality and other ecosystem services in the watershed over the next 30 to 50 years.

Lessons learnt:

- If about 10% of the current forest cover were lost, then the entire watershed would, on average, be below state water quality standards.
- If all forest area currently not conserved were done so via a conservation easement or fee purchase, this would yield a net benefit for the catchment. Every dollar invested in forestland conservation is likely to yield between $4.80 and $8.90 in benefits, including the preservation of water quality. A PES scheme with payments between US$ 4.26–US$ 5.78 $ha^{-1}yr^{-1}$ would be justified from the operator's perspective and would more than cover the required costs of forest conservation.
- There is a business case for commercial water users to invest in watershed protection. If PWD would have to build a filtration plant costing about $150 million dollars, due to forest loss, then water rates would increase by 84% to offset costs of constructing and maintaining the plant. This equates to more than $1.7 million per year in additional water charges for the top 10 consumers in the District.

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