Mainstreaming investments in watershed services to enhance water security: Barriers and opportunities

Adrian L. Vogl,†, Joshua H. Goldstein, Gretchen C. Daily, Bhaskar Vira, Leah Bremer, Robert I. McDonald, Daniel Shemie, Beth Tellman, Jan Cassini

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ABSTRACT

Watersheds are under increasing pressure worldwide, as expanding human activities coupled with global climate change threaten the water security of people downstream. In response, some communities have initiated investments in watershed services (IWS), a general term for policy-financial mechanisms that mitigate diverse watershed threats and promote ecosystem-based adaptation. Here, we explore the potential for increasing the uptake and impact of IWS, evaluating what limits its application and how institutional, financial, and informational barriers can be overcome. Our analysis complements the growing literature on individual programs by identifying levers at regional and global scales. We conclude that mainstreaming IWS as a cost-effective strategy alongside engineered approaches will require advances that (i) lower institutional barriers to implementation and participation in IWS; (ii) introduce structural market changes and standards of practice that account for the value of watersheds’ natural capital; (iii) develop practical tools and metrics of IWS costs and benefits; and (iv) share success stories of replicable institutional and financial models applied in varied contexts.

1. Introduction

Human societies depend on reliable supplies of clean water to support an increasing population and rising living standards, while ensuring health and well-being in the face of changing climate conditions. Yet, as forests decline, farmlands expand, and cities grow, people are often compromising the ability of ecosystems to ensure clean water flows (Foley et al., 2005; Palmer et al., 2015). This situation complicates the substantial challenges facing governments, development agencies, and corporations, who will need to make sizable investments in water infrastructure – an estimated US$11.7 trillion between 2013 and 2030 – to keep pace with human needs in the coming decades (Dobbs et al., 2013).

To meet these challenges, an alternative approach to securing clean water supplies through protecting and restoring ecosystems (also referred to as ecosystem-based adaptation) has emerged in a growing number of programs globally (Critchley et al., 2008; Goldman-Benner et al., 2012; Talberth et al., 2013). Broadly termed Investments in Watershed Services (IWS), these programs are motivated largely by three premises: (1) addressing water quality challenges at their source may be more cost-effective than mitigating problems downstream, (2) protecting source water areas can in some cases – such as cloud forests (Bruijnzeel, 2004) and páramo (Buytaert et al., 2006) – provide water quantity benefits, and (3) in some cases enhance reliability of local supplies through hydrologic regulation (Richter et al., 2013; Bennett and Carroll, 2014). These water quantity and quality benefits from well-functioning terrestrial ecosystems are generally referred to as hydrologic, or watershed, services (Brauman et al., 2007). Generally, IWS programs support a portfolio of activities tailored to local conditions to protect and restore ecosystems or to implement agricultural best practices, with the goal of protecting or restoring these watershed services.
Following the definition used by Forest Trends (Bennett and Carroll, 2014) in their global survey of investments in natural infrastructure to secure water, we use the term IWS here to encompass a broad category of finance and governance structures that fund watershed restoration or protection in order to secure its benefits to society. Programs included under this umbrella can take many different forms, from public investments in land conservation to private PES schemes to philanthropic investments or a mix of all these. A common feature is that they aim to link upstream service providers with downstream beneficiaries, and may include payments for watershed services, water funds, source water protection programs, reciprocal agreements for water, and ecosystem compensation, just to name a few.

Engineered approaches will undoubtedly remain an essential component of future water sector investments (Muller et al., 2015); however, such approaches can be prohibitively costly in an era of increasing fiscal constraints (Rodriguez et al., 2012). Moreover, built infrastructure that is fixed in location and capacity, or that transfers water over long distances, may lack resilience to climate change, especially when contrasted with ecosystem-based adaptation achieved through adaptively managing watersheds (Wertz-Kanounikoff et al., 2011). IWS provides a complementary approach, though not a full substitute, to engineered approaches, by diversifying strategies for water security and potentially providing environmental and social co-benefits as well (Palmer et al., 2015).

A 2013 survey reported at least 345 IWS programs in operation globally with an annual investment totaling US$12.3 billion (Bennett and Carroll, 2014). More broadly, awareness of natural solutions is growing in both public (e.g., Sabatier et al., 2005; Bennett et al., 2014) and private sectors (e.g., Lambooy, 2011; Money, 2014) and there are likely many more programs aimed at securing watershed services that are not captured in this total. Yet, despite rapid growth – from less than 50 self-reported programs in 2000 to 345 in 2013 (Bennett and Carroll, 2014) – IWS remains a relatively small-scale and place-specific approach rather than a sectoral strategy broadly supported by existing policies, financial mechanisms, and institutional norms. This contrasts starkly with the widespread use and support for engineered solutions in the water sector.

Research suggests that watershed services can be well-suited to IWS arrangements, particularly where a single downstream beneficiary may be identified or created through policy interventions (Brouwer et al., 2011; Farley and Costanza, 2010; Kemkes et al., 2010). Given that IWS has the potential to be a cost-effective and complementary water security strategy, why does its application remain limited, and how can barriers to its adoption be overcome? Here, we aim to identify pathways by which water resource planners and infrastructure investors could routinely integrate natural solutions alongside engineered approaches in strategically-designed portfolios.

There is a growing literature on IWS design, implementation, and evaluation, but most research focuses at the scale of individual programs. The focus tends to be on local aspects of IWS design, whether ensuring efficiency (e.g., Galler et al., 2015; Wünscher et al., 2008), or balancing it with social equity and responsiveness to local concerns (e.g., Kovačs et al., 2016; Muradian et al., 2013; Narloch et al., 2011). While we agree that these local design factors are critical, our aim in this paper is to complement this literature by identifying regional and global enabling conditions to make IWS more attractive, relevant and widespread to decision makers from local to global scales. IWS programs will always face difficult choices as local providers and beneficiaries of watershed services are engaged, choices relating to tradeoffs between economic efficiency, equity, and other social and environmental considerations in planning and management (Vira and Adams, 2009; Muradian et al., 2013). Yet, removing major barriers could help ensure that these options are considered alongside engineering approaches and adopted where appropriate.

Turner and Daily (2008) identified three barriers to increasing investment in ecosystem services, which provide a useful framing to evaluate the obstacles to mainstreaming IWS. First, decision-makers face an “institutional failure” in that downstream communities reap benefits from watershed management, yet upstream land stewards incur the costs of such activities. IWS provides incentives to overcome this failure by transferring resources from downstream to upstream actors, thereby helping to overcome jurisdictional mismatches, integrating siloed and sectoral approaches, and aligning resource and governance boundaries. Yet, the suitability of these arrangements depends importantly on institutional context (Kovačs et al., 2016; Muradian et al., 2013), and local actors often face disincentives or legal structures that impede its consideration (Bennett et al., 2014).

Second, a “market failure” – due to economic externalities and the physical characteristics of water as a common pool resource – incentivizes downstream water users to free ride off benefits provided by upstream communities. Yet current market structures – such as pervasive undervaluation of the benefits of watershed stewardship and a lack of widely supported financial mechanisms to overcome this market failure – impede the widespread adoption of IWS (Postel and Thompson, 2005).

Finally, decision-makers face an “information failure” regarding the magnitude and distribution of how nature benefits people at scales pertinent to decisions. While water sector planners have the knowledge and tools needed to quantify the costs and expected water security gains from engineered solutions, they lack comparable information for natural solutions (Talberth et al., 2013).

Based on these challenges, we propose three major advances needed to mainstream IWS: (i) address cross-cutting institutional barriers through policies that encourage upstream and downstream actors to partner for mutual benefit, (ii) fully value the contribution of watersheds to securing clean water supplies through supportive policy and market structures, and (iii) generate the science and practical tools needed by institutions to evaluate and incorporate IWS. Across all of these, there is a need to synthesize and share knowledge and models for success, reaching beyond academia and the environmental community to professional societies and major actors in the water sector.

We discuss each of these proposed advances, drawing upon the literature and our collective experience. Scaling IWS will require scientific, financial, and policy tools beyond the needs of individual programs to expand participation from national and local governments, corporations, development agencies, and others who are key to the future of the water sector.

2. Institutions

Unlike engineered solutions implemented at a single site (e.g., water treatment plant), IWS strategies are often more complex, as they require the coordinated action of many actors within a physically-defined watershed, frequently across governance and cultural boundaries. There is often little or no precedent for these actors to recognize their mutual interest nor existing incentives to cooperate (c.f. Bennett et al., 2016; Biswas, 2008). This increases transaction costs, further decreasing the incentive for cooperation. The often large number of small landholders in many source watersheds presents challenges to implement (and monitor) land use change at a scale that matters for water security. In addition to these efficiency challenges (Kemkes et al., 2010), issues of trust, transparency, power dynamics, and equity are pertinent when designing programs and incentives at all levels (Pascual et al., 2014; Corbera et al., 2007; Muradian et al., 2010). Designing IWS programs that overcome these challenges thus presents a significant collective action problem (e.g., Vira et al., 2012; Muradian et al., 2013).

Here, we focus on (i) understanding the roles and interests of key actors in the water sector, (ii) matching institutional with watershed-scale goals, and (iii) broadening engagement. Collectively, these advances would create more conducive enabling conditions and policies for IWS at regional and global scales that can help to lower transaction costs and perceived risks for local actors.
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