Ecosystem Services 16 (2015) 83–93

Contents lists available at ScienceDirect

Ecosystem Services

journal homepage: www.elsevier.com/locate/ecoser

Institutional analysis of payments for watershed services in the western United States

Heidi R. Huber-Stearns [a,*], Joshua H. Goldstein [b], Antony S. Cheng [a], Theodore P. Toombs [c,d]

[a] Department of Forest and Rangeland Stewardship, Colorado State University, Fort Collins, CO, USA
[b] Central Science, The Nature Conservancy, Fort Collins, CO, USA
[c] Department of Human Dimensions of Natural Resources, Colorado State University, Fort Collins, CO, USA
[d] Environmental Defense Fund, Boulder, CO, USA

ARTICLE INFO

Article history:
Received 12 December 2013
Received in revised form
27 February 2015
Accepted 17 October 2015
Available online 30 October 2015

Keywords:
Cluster analysis
Ecosystem services
Environmental governance
Incentives
Water rights

ABSTRACT

Payments for watershed services (PWS) have emerged as one of the fastest growing segments of the broader conservation strategy of payments for ecosystem services over the past decade. Institutional factors are key to the design and performance of PWS, yet empirical research remains a gap in the literature. Here, we collected and analysed information on the institutional characteristics of the 41 active PWS programs in 2012 in the western United States, a region containing one of the highest concentrations of PWS globally. Cluster analysis identified four main groupings around buyer types and management actions. Many programs pursued a PWS structure as a new approach, often including participants in new roles (e.g., nongovernmental organizations as facilitating transactions), to comply with existing regulations or addressing escalating water resource threats. Our results highlight the important interactions between overarching regional factors (e.g., federal policies, water rights) and diverse local conditions (e.g., land ownership, resource challenges) in shaping the institutional structure of individual PWS programs. A key gap remains collecting robust information on PWS performance. As such, this work provides a baseline for future longitudinal institutional analysis to link program structure and performance to inform PWS research and practice.

1. Introduction

Payments for watershed services (PWS) have emerged over the past decade as one of the fastest growing segments of the broader conservation strategy of payments for ecosystem services (PES). At least 347 programs are actively operating in 29 countries for a minimum estimated market value of $9.57 billion in 2013 and a total value of $66 billion from 1995–2013 (Bennett and Carroll, 2014). Payments for watershed services are defined as, "Mechanisms where a clear buyer and seller (generally, representing the "beneficiary" and "provider" of watershed services, respectively) exist, where some form of remuneration for providing those services takes place, and where the primary motivation is clearly water" (Bennett et al., 2013, p. 3).

Payments for watershed services encompass groups of interacting organizations and institutions that combine elements of the state, markets, and civil society to address collective-action dilemmas in novel ways (Armitage et al., 2012; Muradian et al., 2013). Literature inventorying and analysing PWS programs has identified substantial diversity in the types of program drivers, actors, target ecosystem services, financing mechanisms, and other institutional factors that are being categorized under the umbrella of PWS (e.g., Bennett et al., 2013, 2014; Bennett and Carroll, 2014; Brouwer et al., 2011; Hanson et al., 2011; Majanen et al., 2011; Porras et al., 2008; Smith et al., 2006; Talberth et al., 2012).

Analysis of PWS sits within the broader evaluation of institutional frameworks for PES (Brouwer et al., 2011; Corbera et al., 2009; Muradian and Rival, 2013; Tacconi, 2012; Wunder, 2013). Institutions have important influence in the design and performance of PES (Corbera et al., 2009). Existing institutions, including legal frameworks, property rights and social perceptions, affect how PES can be used as a mechanism for land management across a variety of actors (Vatn, 2010). Applying an institutional lens to PES can, for example, identify interactions with existing policies, impacts on natural resource managers, issues of participation and access, and linkages between local contexts and potential program participants, all of which can inform PES design and operation, and advance institutional theory (Corbera et al., 2009). Institutional analysis frameworks can help researchers discover linkages between design and ecological, economic, and social performance within their cultural contexts and help identify, disassemble, and

* Correspondence to:Department of Forest and Rangeland Stewardship, 1472 Campus Delivery, Colorado State University, Fort Collins, CO, 80523, USA. Fax: +1 970 491 2255.
E-mail address: Heidi.huber-stearns@colostate.edu (H.R. Huber-Stearns).

http://dx.doi.org/10.1016/j.ecoser.2015.10.009
2212-0416/

resolve ineffective parts of institutions (Ostrom, 2005).

Despite the increasing attention to and focus on institutional analysis in PES, corresponding empirical research is limited (Muradian et al., 2010; Vatn, 2010). Here, we address this gap by conducting an institutional analysis of the 41 active PWS programs in the western United States (US) as of 2012. This region is a valuable focus to advance understanding of PWS as an institution, because: first, it represents one of the most concentrated regions globally for active programs (Bennett and Carroll, 2014), yet research to date has focused on case studies and/or certain actor groups rather than a full population analysis (e.g., Anderson et al., 2012; Bennett et al., 2014; Ivey et al., 2006; Loehman and Charney, 2011; West, 2011); second, programs in the western US are subject to both common regional (e.g., US federal policies, similarities in western US water law) and diverse local (e.g., state management of instream flows, land ownership patterns) institutional conditions; and third, the western US is a microcosm of the complex socio-ecological challenges at play globally that are contributing to the implementation and expansion of PWS (e.g., competing demands on water for human and environmental uses, increasing fires, droughts, and other catastrophic events threatening water resources (Fahlund et al., 2014; Loehman and Charney, 2011; Robbins et al., 2009; Theobald et al., 2013; Warziniack and Thompson, 2013; West, 2011)).

To conduct our analysis, we identified common variables of interest to create an institutional framework, informed primarily by Ostrom's (2009, 2011) well-established and widely utilized Institutional Analysis and Development and social–ecological systems frameworks and Corbera et al. (2009) PES-specific institutional framework. We used this framework to characterize and analyse key institutional factors that describe the population of PWS programs in the western US. Our aim is to provide an institutional characterization of the region's PWS population, and from comparing and contrasting programs in the region, develop broader insights to advance theory and practice for how PWS is being deployed as an institution to address socio-ecological challenges.

2. Methods

2.1. Study region

Our study region encompassed the eleven states of the western US including Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. These states cover approximately 3.1 million square kilometers (32% of the US), are home to over 73.5 million people (23% of US population), and contain the highest concentration of federal land ownership in the contiguous 48 states (47% of land area in the region) (Fahlund et al., 2014; Gorte et al., 2012; U.S. Census Bureau, 2010', 2014).

Competing demands on water for growing populations (especially cities), agriculture and environmental needs are rising (Anderson et al., 2012; Fahlund et al., 2014). These needs are made particularly challenging in a region with variable precipitation patterns across a generally arid and water limited region (Fahlund et al., 2014; Theobald et al., 2013). Drought-induced risks such as water supply and wildfire are important issues facing urban and rural communities (Warziniack and Thompson, 2013; West, 2011).

Legal structures regulating access to water are an important component of the region, with states adhering to the "prior appropriation" doctrine. This doctrine allocates water use through the principle of 'first in time, first in right', meaning the order in which water users started diverting water from rivers created the delineation of water use priority over time (Landry, 1998). This doctrine did not initially consider instream water flows for environmental benefits as a defined beneficial use. However, states did create a legal mechanism for water rights transfers to support instream flows (thus addressing the restriction imposed by prior appropriation) beginning in the 1960s and 1970s (Anderson et al., 2012; Landry, 1998). In addition to the prior appropriation doctrine, water rights and access are affected by policies, rules and decisions from the local (e.g., water districts and roundtables) to state (e.g., water court and legislature) and federal levels (e.g., federal agencies, Congress, US Supreme Court) (Gallaher et al., 2013).

2.2. Study design

We created a framework for our institutional analysis based primarily on Ostrom's Institutional Analysis and Development (IAD; 2011) and social–ecological systems analysis (2009) frameworks, and Corbera et al. (2009) PES framework. We also reviewed literature on institutional analysis of PWS and PES, (including: Brouwer et al., 2011; Engel et al., 2008; Majanen et al., 2011; Muñoz Escobar et al., 2013; Muradian et al., 2010; Vatn, 2010) to identify common variables of interest. IAD provides an established policy analysis framework for evaluating and comparing programs with differing structures, as is the case in our study region of the western US (Ostrom, 2005). This framework includes the external context, such as the existing governance system, actors, resource system, and units that exist in our study region as components for institutional analysis. The institutional analysis components also include a common set of Program Structure variables to characterize PWS structures related to program participants (or actors) and how programs produce outcomes (Ostrom, 2005). These components include variables such as Actors and Roles, Actions, Participation, Financial Incentives and Deterrents, and Outcomes (Table 1).

Corbera et al.'s (2009) analysis of institutional dimensions of PES identified five analytical domains, which we drew upon for our analysis (listed as Analytical Domains of PWS in Table 1). These domains include:

1. Institutional design: how rules are designed, change over time, and affect goals.
2. Institutional performance: how ecosystem services (or main water related) provision is measured (e.g., increases in water flow, tons of sediment removed) and monitored, and understanding if an institution is achieving its goals.
3. Institutional interplay: how PES accounts for and affects other existing institutions (encompassing policies and programs).
4. Organizational capacity: the capacity of actors involved and the effects of capacity on performance.
5. Scale: how the design and performance of PES is affected by scale, and the role of cross-scale work.

We adopted these components of IAD and institutional dimensions of PES as the basis for our survey questions and analytical framework, by identifying variables that explain the institutional components of PWS (Table 1).

2.3. Survey design and administration

We designed and administered an online survey from July to October 2012 to collect information on active PWS programs in the western US. Programs were defined as active, if transactions had occurred in the period 2009–2012. We conducted the survey in partnership with Forest Trends' Ecosystem Marketplace, which was undertaking its second global review of PWS programs (Bennett et al., 2013). We obtained information on 41 active