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Boundary work: Knowledge co-production for negotiating payment for watershed services in Indonesia

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ABSTRACT

Boundary work has been proven effective in bridging research communities and the gap between action and policy-making in sustainable development. Applying this boundary-work framework, the manuscript examines the process of knowledge co-production and evaluates its effectiveness in supporting the negotiation process of four cases of payment for watershed services (PWS) in Indonesia. Our case studies reveal that local communities and policy-makers have a diverse range of knowledge regarding watershed functions and services. Recognizing this knowledge diversity, and combining it with scientific information, leads to (i) enlightenment, by engaging local stakeholders in more active roles for knowledge co-production thus setting realistic targets for ecosystem services' interventions in the design of PWS schemes; (ii) decision-making support for stakeholders, by providing opportunities for collaborative learning; and (iii) effective negotiations, by providing salient and credible information. We recognize 10 different prototypes that lead to a better understanding of how payments can be channeled to enhance, or at least maintain, underlying hydrological functions. The case studies, in different landscape configurations and associated PWS prototype settings, show that knowledge interfacing and sharing towards co-producing collaborative products helps to clarify the performance-based indicators for effective PWS negotiation between potential sellers and buyers of ecosystem services.

1. Introduction

Watershed degradation affects fresh water supply and quality, and increases the frequency of water-related disasters. It thus has a negative impact on human wellbeing. However, increased land-use intensity in upland areas also provides livelihood options for a growing population. Balancing the trade-off between the economic gains of more intensive land use and the insurance investment in watershed conservation working towards healthy watersheds is a decision-making challenge (Barbier and Burgess, 1997; MA, 2005). The short-term benefits of intensification commonly lead to increased exposure to climate risk and a possible downward spiral into land degradation. To achieve both livelihood and conservation goals, policy instruments, such as public investment and market-based instruments, can build enabling environments to manage this trade-off and shift land-management decisions (Braat and de Groot, 2012; Tomich et al., 2004).

Inspired by the way Costa Rica reformed its existing forest subsidy scheme into a Payments for Ecosystem Services system in the 1990s (Chomitz et al., 1999), the last decade has seen broader experimentation with markets and payments for watershed services and with policy and institutional options for watershed management elsewhere (e.g. in Asia and Africa) (Adhikari and Boag, 2013; Leimona et al., 2015; Namirembe et al., 2014). The process of design and negotiation required to establish a sustainable Payment for Watershed Services (PWS) scheme is knowledge-intensive, involving multiple actors and potentially conflicting objectives with diverse and dynamic multi-faceted knowledge systems.

One major challenge of the negotiation process is that key actors often propose and develop plans for watershed policy based on perceptions rather than scientific realities, local ecological knowledge acquired by direct contact with the environment (Chapman, 2002; Schalenbourg, 2004) and locally-evolved ecosystem management practices (Berkes, 1999; Berkes et al., 2000)[1]. According to Maiello et al. (2013), public services managers often rely purely on expert and

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[1] In this paper, the level of analysis of 'local ecological knowledge' is part of the broader concept of 'Traditional Ecological Knowledge' or TEK (Berkes, 1999, 2000). The TEK encompassed management practices based on ecological knowledge, and social, historical, cultural and institutional mechanisms behind management practices. 'Local Ecological Knowledge' focuses on management practices based on local communities' ecological knowledge. These practices could integrate both conventional resource management, and local and traditional society's ones with various degrees of combination.

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administrative knowledge and do not integrate political, scientific and community perspectives. From the perspective of scientific knowledge, the predictive skill of hydrological models that are not calibrated using local data is still disappointingly low, despite major international efforts to remedy this shortcoming (Hrachowitz et al., 2013). On the other hand, local data may not be readily available or, when they are available, of uncertain reliability. Nonetheless, watershed rehabilitation efforts, including those involving a PWS scheme, mostly neglect local farming practices and wisdom (Joshi et al., 2004b). Many concentrate on large-scale tree planting as a 'one-size-fits-all' solution, tackling environmental issues as if they were mere technicalities (Maiello et al., 2013).

Given the complexities involved, an operational model that enables knowledge interfacing and sharing, to facilitate and support the complex negotiations, is essential for developing a sustainable flow of incentives for watershed provision. The principles of knowledge interfacing and sharing assume that knowledge is produced jointly (co-production of knowledge) through collaborative learning between 'experts' (i.e. scientists) and 'users' (i.e. managers and decision-makers) (Roux et al., 2006). The central challenges for knowledge co-production are to respect the complementarity of knowledge systems, to integrate multidisciplinary collaboration within science, and to enhance the growth of relevant, legitimate and credible evidence-based input from any of the contributing knowledge systems. Indeed, scientific inquiry cannot thrive without a safe space, protected from political correctness, stakeholder vested interests and existing policy frameworks. Thus, the (knowledge) boundary between science and action needs to be semipermeable (Van Noordwijk et al., 2009a).

The conceptual framework for analysis of ecosystem services that was successful in science-policy arenas (Reid et al., 2006) does not necessarily match local knowledge systems and conceptualizations (Tomich et al., 2004). Knowledge in this context can be defined (Joshi et al., 2004a) as a logical interpretation of qualitative or quantitative observations ('data'), acquired directly or indirectly from other sources, used to convey understanding that can be articulated and recorded independently of the interpreter and used for predictions and decisions. Knowledge systems include the way knowledge changes by various modes of learning. An effective method for representing the apparent logic of local or public/policy knowledge consists of dissecting statements into their unitary elements that describe relations (of a correlative or causal nature) of many contextual entities (Dixon et al., 2001). It builds up a local vocabulary that may or may not have equivalents in other languages, and is careful in retaining context to statements made. A description of a knowledge system then includes a dictionary of terms (often in a generic-specific hierarchical relationship) and a set of relationships between these terms. The degree to which correlative and causal relations are differentiated, as well as the number and types of 'causes' that is invoked can vary between knowledge systems. Knowledge systems of a similar 'domain' can differ in the entities (vocabulary), types of relationships, context-specificity of relationships and the types of new data (observations) that is needed to modify established interpretation. Scientific knowledge has generally started off as a subset of public knowledge, but it is stricter on the types of evidence it allows, keen on reducing context-specificity of explanations (seeking generalizations that are robust) and restrictive on the types of forces it invokes as explanatory factor.

Where knowledge systems differ, firstly, the practical implications for what to do or not to do may still match. In a well-studied example, (Lansing, 2012) documented how traditional *subak* institutions for management of irrigated rice-fields on Bali were in fact ecologically superior to 'modern' technically derived irrigation systems. The local knowledge systems, expressed in procedures that lead to synchronicity in the start of a new growing season, used a different rationale than ecological analysis of pest pressure and water availability, but the resulting practice was aligned. Secondly, it is a judgement call whether or not any difference in rationales matters and is an obstacle to communication and negotiation. As long as they support similar decisions and indicative value systems, differences can be accepted as a mutually enriching diversity, but where they lead to contradictory outcomes (e.g. 'trees increase water flows' versus 'trees decrease water flows'), exploration of context and observational roots of the statements may be needed before progress can be made (Van Noordwijk et al., 2009b).

Boundary work, the analysis of boundaries in a knowledge-action system, is defined as 'the process through which the research community organises its relations with the worlds of action and policy making' (Cash et al., 2002; Clark et al., 2010). Boundary-work studies undertaken in the context of developing economies have explored how knowledge generated by (a) a single discipline; or (b) multiple disciplines and knowledge systems, can be used for (i) general enlightenment (contextual clarification); (ii) decision-making support for stakeholders; and (iii) negotiations among multiple stakeholders who have and selectively use multiple knowledge claims (Clark et al., 2011). The use of knowledge for negotiation support is the most complex form of boundary work and, as emphasized by Clark et al. (2011), the information used during this process needs to be salient (i.e. information about providing ecosystem services and joining a PWS programme, in terms relevant to the local watershed context), credible (i.e. technically adequate according to ecosystem services' measurements), and legitimate (i.e. 'fair, unbiased and respectful of all stakeholders'). There are manifold challenges to the effective integration of these types of knowledge into negotiations and decision-making: salience requires that the knowledge shared is contextualized and participative; the credibility of multiple knowledge systems must be demonstrable; and it is crucial that knowledge claims can be proven as legitimate, as conditions of such negotiations are often politicized and contested.

This paper investigates the lessons learned about boundary work for payment for watershed functions in Indonesia drawn from the Rewarding Upland Poor for Environmental Services (RUPES) [2] action-research network, coordinated by the World Agroforestry Centre. Previous research on boundary work in integrated natural resource management carried out in Indonesia for the Alternative to Slash and Burn (ASB) programme of the CGIAR, a global research partnership for a food-secure future, concluded that the ASB-RUPES project had succeeded in creating multiple forms of boundary work as the basis for conflict negotiation and the key 'win/win' option (Clark et al., 2011). Our current research sought to extend this work by further exploring, comparing and evaluating the effectiveness of boundary work in four PWS cases in Indonesia. Using Rapid Hydrological Appraisal (RHA), a tool for scoping PWS schemes (Jeanes et al., 2006), we firstly systematized the captured diversity of knowledge regarding landscape characteristics, problems, and related land-management issues among local watershed managers. These managers are usually farmers making decisions about their land practices and government officers acting as policy providers. Secondly, we highlighted concordances between these perceptions and knowledge claims regarding the cause and effects of watershed problems by checking hydrological modeling produced for each RHA report. We inquired, in the context of boundary work, whether this process could potentially expose logical contradictions and enhance the credibility

[2] RUPES is an action-research network on payment for ecosystem services in Asia that was initially funded by the International Fund for Agricultural Development , 2002–2006 (Phase I) and 2007–2011 (Phase II). Research continues by the World Agroforestry Centre as part of the CGIAR Research Program on Forests, Trees and Agroforestry.