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Methods

Negotiation analysis for mechanisms to deliver ecosystem services: The case of soil conservation in Costa Rica

Raffaele Vignola [a,b,c,*], Tim L. McDaniels [a,c], Roland W. Scholz [b]

[a] Adaptation, Ecosystem Services and Land Use Policy Research, Climate Change Program, CATIE, 7170 Turrialba, Costa Rica
[b] ETH Zurich, Institute for Environmental Decisions, Natural and Social Science Interface, 8092 Zurich, Switzerland
[c] Institute for Resources, Environment and Sustainability, and School of Community and Regional Planning, University of British Columbia, United States

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ABSTRACT

The nature and structure of institutional mechanisms is fundamental for commons management, and yet has received relatively little attention for ecosystem service provision. In this paper, we develop and employ a value-focused structured decision process for a negotiation analysis about mechanisms to maintain and enhance ecosystem service (ES) provision at the watershed scale. We use a case study in the Birris watershed of Costa Rica where upstream farmers and downstream hydropower might jointly benefit from the design of a mechanism to foster the provision of soil regulation services (SRS). We identify and use parties' fundamental objectives, and views on means to achieve these objectives, to structure a negotiation template representing the important components that a soil conservation program should include. A voting-based elicitation process was employed to identify sub-alternatives acceptable both parties, which in turn identifies the zone of bargaining, or negotiation space in which future negotiations should focus. We conclude with discussion of the potential for application of this approach to other ES contexts, and the importance of the overall policy framework to provide resources and incentives to achieve enhance ES provision.

1. Introduction

A wealth of research indicates that cooperation to avoid degradation in commons contexts (such as use of shared water resources) requires effective institutional arrangements,[1] which may include incentives, information-sharing, rules for cooperation and feedback mechanisms acceptable to concerned parties (Dietz et al., 2003; Habron et al., 2004a, 2004b; Koehler and Koontz, 2008; Woolley et al., 2002). The Birris watershed of Costa Rica, where this research is situated, is an example: effective and acceptable institutional arrangements could encourage upstream water users (small scale farmers) to take steps to reduce erosion from their farms, in order to create benefits for downstream water users such as hydroelectric facilities (Guo et al., 2000; Pimentel et al., 1995; Southgate and Macke, 1989), potentially reducing costs to society as a whole (Vignola et al., 2010b).

Given the grim outlook for many kinds of services derived by humans from environmental systems (MEA, 2005),[2] economists have devoted much attention to financial incentives in the form of payments for ecosystem services (PES) to foster economically efficient solutions for maintaining or enhancing eco-system services (Engel et al., 2008; Ferraro, 2008). While PES schemes do provide direct financial incentives, they also assume that direct payments are what upstream producers want and need as institutional arrangements for maintaining eco-system services (ES) within water management contexts. Some researchers have argued that the "commodification" required by PES may oversimplify an array of complex values and relationships that arise in management of shared water resources and be difficult to implement in practice under a strict market mechanism (Kosoy and Corbera, 2010; Muradian et al., 2010). An understanding of institutional settings, social contexts, distributional issues, the values of concerned parties and technical knowledge of what is possible are all required in order to develop mechanisms for enhancing ES conservation (Dietz et al., 2003; Muradian, et al., 2010).

* Corresponding author at: Adaptation, Ecosystem Services and Land Use Policy Research, Climate Change Program-Tropical Agriculture Research and Higher Education Centre (CATIE), 7170 Turrialba, Costa Rica. Tel.: +506 25582528.
E-mail address: rvignola@catie.ac.cr (R. Vignola).

[1] "Institutional arrangements" can be defined as "an assemblage of rules, decision making procedures and programs that give rise to social practice, assign roles to participants and govern interactions" (Young, 2003). These arrangements may be formalized, clearly delineated and highly structured, or more informal and adaptive, depending on the contexts.

[2] Within the typology developed for the Millenium Ecosystem Assessment, these include: *provisioning services* such as food, water, timber, and fiber; *regulating services* that affect climate, floods, disease, wastes, and water quality; *cultural services* that provide recreational, esthetic, and spiritual benefits; and *supporting services* such as soil formation, photosynthesis, and nutrient cycling (MEA, 2005:9).

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There are several reasons to consider a wider array of institutional arrangements than a strict PES framework to encourage ES provision. One reason is the difficulty for either consumers or producers of ES to determine the appropriate market price for service provision in a specific location, given high transaction costs, lack of experience with different land or water use arrangements, and uncertainty over the outcomes of specific practices (e.g. Wunscher et al., 2008). A second reason is that for certain kinds of ES, the locations crucial for maintaining service provision are limited and specific, or tied to critical conditions, so the number of potential suppliers and the potential for transfers of contracts is constrained (Goldman et al., 2007). One might normally expect negotiation to arise as a preferred approach in place of market price in unfamiliar or complex transactions or one-time agreements. Some literature in both economics and decision theory explores when one or the other of these approaches is preferred (e.g., Bajari et al., 2008; Bulow and Klemperer, 1996; Subramanian and Zeckhauser, 2004). Jack et al. (2008) also review differences and similarities with other market-based environmental policies, and discuss why incentive structures other than direct PES may be preferred in some contexts. Yet how institutional mechanisms are to be built in order to foster ES provision has received relatively little attention (Wilson and Howarth (2002) and de Groot and Hermans (2009), are exceptions).

This paper builds on the work of those authors regarding institutional design for ES incentive schemes. Its overall objective is to explore the role of value-focused decision process drawn from applied decision analytic methods (Gregory et al., 2012; Keeney, 1992, 1996) for a *negotiation analysis* regarding *the nature of the institutional structure and form of incentives* for a specific ES provision context. We use a watershed case study in Costa Rica, a country where the pioneering experience on implementation of PES schemes has put little emphasis on agricultural contexts, and has focused on financial incentives rather than other possible mechanisms. In the Birris watershed, upstream farmers could provide better soil regulation services (SRS), which would benefit their farms, and help avoid siltation of reservoirs, and thus reducing costs for hydroelectric utilities downstream. De Groot and Hermans (2009) used an analysis of stakeholder values to outline the potential for PES negotiations between providers and users of water-related ecosystem services. We build on that work in three ways. First, we focus on the components of an institutional mechanism rather than the effectiveness and structure of direct payments to farmers. Second, we put emphasis on the provision of on- and off-site water–soil regulation services that provide potential for joint gains (Wossink and Swinton, 2007) among farmers and hydropower rather than putting emphasis on the provision of services that principally benefit downstream users. Third, we focus on negotiation for the design of the institutional structure that is mutually agreeable to the interested parties.

The standard normative approach to conflict and negotiation is game theory, which seeks normative equilibrium solutions given known alternatives, constrained objectives, and known payoffs.[3] Here we adopt a more behaviourally-oriented, prescriptive approach to analysis of bargaining contexts, with an emphasis on decision structure and process, referred to as *negotiation analysis* (Raiffa et al., 2002; Sebenius, 1992; Young, 1991). The behavioral, prescriptive orientation is selected to help the parties to these potential negotiations better understand their values, create more attractive alternatives and clarify preferences, as a prelude to a successful negotiation (Raiffa et al., 2002).

This paper has two related sub-objectives. One is to show how negotiation analysis informed by structured decision process can help develop more widely supported institutional mechanisms for ecosystem service provision, and serve as an aid for environmental bargaining contexts generally. A second objective is to provide a structure for the negotiation space or *zone of bargaining* among stakeholders in this specific context (Raiffa et al., 2002), and illustrate the relevance of this approach for other contexts. In keeping with the writing on structured decision-making and negotiation analysis, the authors serve as neutral third parties (Raiffa et al., 2002) to help build a *negotiation template* to guide negotiation between the interested parties (electric utilities and farmers).

As outlined by Raiffa et al. (2002), a negotiation template provides ex-ante guidance to help support subsequent negotiations by synthesizing the values of the negotiating parties in terms of a set of objectives for the negotiation context, and uses those values to help create more attractive alternatives. Hence, a negotiation template begins with two sets of objectives, one for each of the negotiating parties, and a creative set of attractive alternatives to be addressed in the negotiation (Metcalfe and Metcalfe;, 2002).[4] In this study, we also identify the potential *zones of bargaining*, that is, components of alternatives on which both parties could potentially agree. Hence a negotiation template is a preparatory systematization of the substantive issues to be considered in future negotiations (Raiffa et al., 2002). Beyond that, initial efforts to improve understanding of the decision at hand by parties on both sides of a negotiation can pay dividends in terms of improved relationships among the parties, and more stable agreements over time (Innes and Booher, 1999; Raiffa, et al., 2002; Sebenius, 1992).

This paper has the following structure. The next section provides an introduction to the Birris watershed ecosystem services context. Section 3 then provides an introduction to negotiation analysis, and the particular characteristics of ES provision in this case study that makes the approach particularly relevant. Section 4 discusses methods used to gather information for this research. Section 5 includes results, in terms of a negotiation template and its evaluation by farmers and the electric utility. Section 5.3 provides conclusions and discusses which aspects of this work may be relevant for other contexts.

2. ES Provision in the Birris Watershed

In 1996, Costa Rica established its national PES scheme, which has been the subject of much recent research (Engel et al., 2008; Pagiola, 2008; Sanchez-Azofeifa et al., 2007). The scheme provides direct monetary incentives for the provision of four types of ecosystem services, namely: biodiversity protection, carbon storage, scenic beauty maintenance and, broadly defined, watershed services (Kosoy et al., 2007; Pagiola, 2008). Only tree-based land management alternatives are considered in the Costa Rica PES system (i.e. reforestation, restoration and protection of forests); other kinds of soil conservation options (e.g. those from agricultural land uses) are excluded. Moreover, the national PES system is applicable in large areas defined by criteria that do not include the potential for ES provision at specific locations (Wünscher et al., 2008). Nevertheless, processes to establish institutional mechanisms for ES conservation may be needed in the near future if revenues from the recently approved water-use fee can be used to pay for enhancing SRS in priority watersheds (Pagiola, 2008).[5]

[3] For a rich discussion on the linkages and differences between game theory and negotiation analysis, see Sebenius (1992). Raiffa et al. (2002) also provides a comparison of game theory and negotiation analysis.

[4] Hence, a negotiation template is similar to a consequence table (objectives by alternatives matrix) in decision analysis (Hammond et al., 1999), except that it is relevant for decisions by two sides in a negotiation.

[5] The water use tax requires hydroelectric companies (and other major users) to pay a water-use tax to the Ministry of Environment (MINAET). A part of these payments could be designated to fund watershed management activities, but this practice has not yet been implemented (Ponce, 2006). One reviewer noted that this regulatory opportunity, and its implementation uncertainty, could affect the willingness of utilities to participate in watershed management, and thus in the negotiation context discussed here. We agree. If utilities were able to designate part of their water use payments toward watershed management, it would reduce the net costs of erosion control to their ratepayers. The converse is also true. However, this uncertainty does not alter the relevance of the basic framework developed here. We return to this topic in Section 5.

The implications of the existing tree-based PES scheme for the present study are that (i) the existing national PES scheme does not cover most activities that would be associated with soil regulation services in agricultural production areas, (ii) the activities the scheme would cover (planting tress over substantial areas) would limit farmers' production capacity in highly intensive small plots of the Birris watershed (i.e. they entail high opportunity costs for agricultural production; Pagiola et al., 2005); and (iii) many of the local farmers are familiar with the basic structure of the national forestry based scheme but have no direct experience on their agricultural plots. Hence these implications are relevant when considering new schemes for the Birris watershed, which is highly significant for soil retention services in Costa Rica.

The Birris sub-watershed (with an area of roughly 5000 ha) is part of the upper Reventazon watershed (which, at more than a thousand square kilometers, it is largest watershed in central Costa Rica). The Birris basin descends from the slopes of Irazu Volcano above the central valley of Costa Rica in Cartago province. The watershed is characterized by rich, deep soils (i.e. andosols) that have attracted many farmers to cultivate vegetables on small to medium sized plots for local markets. Over 300 producers work in the watershed, often on very steep slopes, in locations where annual precipitation exceeds 2300 mm (Marchamalo, 2004). Extreme precipitation events have increased over the last forty years (Aguilar et al., 2005) and are expected to continue to increase as a result of climate change (Magrin et al., 2007). Average erosion rates have increased from 12 t/ha/yr in 1978 when only 15% of the watershed was under horticulture, to over 42 t/ha/yr in the 1990s when agricultural activities occupied more than 30% of total watershed area. The quantities of eroded soils are likely greater at present as the intensification of horticultural cultivation has increased since 1996 (ASA-Pacayas, personal communication, May, 2010). Most of the land is privately owned, with an average plot of 2.9 ha, and with 93% of the plots are under 5 ha in 2003 (Marchamalo, 2004). Some limited information is available on costs of erosion to farmers. On-site costs of soil erosion for farmers have been calculated with the conservative method of nutrient-repletion costs (Alberdi, 2008) yielding an estimate of about 100,000 US$/yearly in the cost of soil loss for the Birris watershed, or an average of about $350 per farm (Vignola et al., 2010b).

The impacts of erosion in the Birris watershed, and its links to hydroelectric facilities downstream, have been investigated in a research project with several regional partners (CATIE, 2003). These hydroelectric generation facilities are adversely affected by siltation that reduces productivity in their rather shallow reservoirs, a situation expected to worsen with increasing erosion due to extreme rainfall events given climate change (Magrin et al., 2007). Both JASEC (a private utility serving the city of Cartago) and ICE (the national electrical and telecommunications utility) operate electrical generation facilities downstream from the Birris watershed, for which costly dam management operations are needed to maintain reservoir energy production. The significance of the Birris watershed for the hydroelectric sector can be seen in data provided by ICE which shows that i) it is the greatest source of agricultural-produced sediments in the Reventazon watershed (ICE, 2000); and that ICE spends up to $4 million annually (as of 2010) in additional generation costs to remove silt and replace foregone power from its reservoirs (Gustavo Calvo pers. Comm., May, 2010). Moreover, the Birris watershed case also provides an important learning opportunity for ICE, which operates hydropower dams in several other watersheds of Costa Rica, and is faced with erosion concerns in many locations.

The situation in the Birris watershed illustrates several points as to why negotiation may be relevant for establishing new incentive schemes and institutional arrangements. The utilities are gaining some experience in providing limited support to farmers for soil conservation practices but not in a formal institution built in agreement with farmers (Vignola et al., 2010b). Utilities and farmers operate at different scales of governance, and different spatial scales, and require new institutional mechanisms in order to address joint interests. While farmers in the watershed understand erosion processes, they have limited awareness of the effects of erosion on downstream hydropower facilities and of how the effects of climate change (in making rainfall more intense) can affect their own farm soils (Vignola et al., 2010a).

As of 2010, the two downstream hydropower companies have initiated some small scale programs to i) increase awareness, ii) encourage voluntary erosion control, and, iii) provide some learning opportunities for soil conservation practices. The local agricultural extension office, also through support of ICE, provides farmers technical assistance including in-kind payments by providing inputs for soil conservation practices (Vignola et al., 2010b) In sum, both groups (farmers and utilities) have limited experience with the costs and structure of soil conservation mechanisms, or their benefits in the face of current and future rates of erosion (ICE pers comm. and ASA Pacayas, pers comm., 2010).

Although institutional design for ecosystem services may seem an unusual context for a structured decision process as a negotiation analysis, it is highly relevant application (de Groot and Hermans, 2009). Writers concerned with providing negotiation advice often speak of the need to negotiate about the process as well as substantive outcomes (Fisher et al., 1991). The structure of the decision context in what follows is more along the lines of institutional design than a more standard negotiation problem; nevertheless it is a new and potentially widely applicable context.

3. Negotiation Analysis for Designing ES Institutions: The Case of Soil Regulation Services

Collaborative planning for complex human–natural systems in real world watershed contexts necessarily involves problem-solving and negotiation among a variety of stakeholders to achieve agreement on action (Fisher et al., 2009; Innes and Booher, 1999). Such efforts should focus on the underlying values of the concerned parties, and ways to create alternatives to achieve those values, using methods directly in keeping with good decision process (Hammond et al., 1999). Raiffa (1982) first explicitly considered how the concepts and methods of decision analysis for a single decision maker could be broadened to serve as the basis for both an art and science of negotiation involving multiple parties. In the early 1990s, a survey article (Sebenius, 1992) and edited book (Young, 1991) delineated negotiation analysis as an analytical perspective on conflict and bargaining, and provided concepts and applied examples to guide these efforts. A more recent book by Raiffa et al. (2002) further develops negotiation analytic concepts and practice.

Negotiation analysis involves situations different than standard contexts for decision analysis, in that agreement among multiple parties is required, and achieving joint gain is possible particularly when multiple objectives are involved. It directly follows decision analytic process (Hammond et al., 1999) in terms of a series of iterative steps involving value perspectives and technical information, with a focus on values of the parties to the negotiation as a basis for constructing and comparing alternatives.[6]

Rather than the normative equilibrium solution of game theory (assuming known rules, players and payoffs), negotiation analysis has an asymmetrically prescriptive/descriptive orientation providing prescriptive guidance on negotiation decision process for one actor, based on descriptions of expected behavior by the other party.[7]

[6] The parallels of decision analysis and negotiation analysis are apparent when one recognizes that Howard Raiffa is one of the main originators of both approaches.

[7] In this paper, we seek to provide support and analysis for both sides in potential negotiations, so its orientation is prescriptive, built on descriptive understanding for both sides.

Negotiation analysis has a Bayesian (subjectivist) perspective on uncertainty and information, and adopts bounded rationality rather than normative optimization in order to be more descriptively relevant regarding the behavior of negotiation participants. It recognizes the benefits of full and open information exchange in negotiation.[8] Drawing on these sources and on the specific context of SRS provision of the Birris watershed (Section 2), we discuss below how key aspects of negotiation analysis are particularly important for designing mechanisms for ES provision.

3.1. Creating or Changing the Negotiation

ES provision requires that involved parties (users and providers) coordinate their actions to achieve their goals. In many cases there might be the need to create a negotiation context or changing existing arrangements to increase social acceptance. More specifically, negotiation analysis can benefit a situation such as ours where the parties interested in watershed services *i*) operate under different institutional contexts (different incentives, laws, markets), and *ii*) have different cultural backgrounds as well as different operational needs.

3.2. A Focus on the Values of the Negotiating Parties

The values of the parties are the reason why they may wish to negotiate and achieve joint gains. Recognizing the differing cultural and institutional contexts, stakeholders' values for ES provision will necessarily involve multiple objectives (Ison et al., 2007; Kosoy and Corbera, 2010). Keeney's *value-focused thinking* (1992) is an applied decision-structuring approach for characterizing values for any decision context, including multi-party negotiation, as discussed in the next section. Raiffa et al. (2002) indicates that value-focused thinking, separately for each party, is a fundamental step in developing a negotiation template, as introduced in Section 1.

3.3. Creating Attractive Alternatives that Expand the Benefits, and are More Likely to Facilitate Agreement

Negotiation analysis built on value-focused thinking attempts to create new, more attractive alternatives that are both more likely to be implemented, and more likely to address the full range of objectives among the parties (Raiffa et al., 2002). In this manner, the parties have an opportunity to expand the potential benefits of agreement, rather than only focusing on claiming benefits.[9] Reaching agreements based on relevant stakeholders' values can support the design of more socially-stable management strategies (e.g. building trust and mutual learning) that are important for longer-term adaptive solutions needed in ES protection (Innes and Booher, 1999).

4. Methods

4.1. Overview

Negotiation analysis follows a series of steps drawn from the writing on good decision process: agreement on the decision context, clarifying the objectives of the negotiating parties (based on their values and motivations), and creating attractive alternatives more likely to achieve wide among the negotiating parties (Hammond et al., 1999; Keeney and Raiffa, 1993; Keeney and Raiffa, 1991; Raiffa, et al., 2002). These steps are pursued separately with the two sides to the negotiation: the intent is to build a negotiation template to inform the thinking, deliberation and subsequent negotiation. In this case, we are building a negotiation template for the design of an appropriate mechanism for ecosystem service provision, specifically, erosion control. The overall procedure used to develop the negotiation template in this study (and the outputs from each step) is shown in Fig. 1.

The conceptual and applied basis for these methods is Keeney's value-focused thinking (1992), a decision-structuring method drawn from applied decision analysis, as noted in the previous section.[10] This approach begins by analysts asking what matters in the views of decision makers and interested parties for the decision context at hand. It then uses that information to develop a set of fundamental objectives, or the ends of concern for the decision at hand, which are then used to *i*) create better, more attractive alternatives, *ii*) define information needs, and *iii*) serve as the basis for formal or informal evaluation (Gregory and Keeney, 1994; Keeney, 1992). The approach has had wide application in a variety of contexts, including environmental management, business strategy, defense, engineering, and planning, particularly for citizens' involvement in complex decisions (McDaniels et al., 1999) and recently in negotiations for PES (de Groot and Hermans, 2009). Throughout this process the authors served as both process designers and facilitators (Holsapple, 1998). In contrast to conventional stakeholder processes, the two groups did not meet together. In what follows, we briefly expand on these methods, but leave some details to subsequent discussion of results.

4.2. Setting the Decision Context (Step 1)

In a more standard negotiation context, such as negotiating the price of an asset, the context and parties may be obvious. But in a context such as negotiation to develop a mechanism to deliver ES, there are many potential barriers that could affect negotiations, which would benefit from a clearly articulated, shared understanding of how each side sees the issue.

We noted earlier that the potential parties to negotiation for ES may be spatially and administratively separated, and have entirely different views regarding the resource issues at hand. In this project, we used different methods and information sources for understanding the broad perspectives of each side. For *Farmers*, we relied in part on the results of a substantial interview-based survey, completed for an earlier component of a larger project (Vignola, et al., 2010a). The survey (n = 56) provided information on farmers' perceived and concrete challenges, barriers and resources for implementing soil conservation practices in the Birris watershed such as i) awareness of actual and potential consequences of soil erosion on their farms' soil productivity, ii) limited access to resources and technical assistance programs to implement alternative practices, and iii) high perceived and concrete opportunity cost of land (due to the intensive use of land in small farms) (Vignola et al., 2010a). We also conducted two focus groups through the local agricultural extension office, to learn how issues of soil erosion and efforts to conserve soil are viewed. For the *Hydroelectric sector* we used corporate documents [11] and interviews (n = 4) with officials of JASEC including the vice-president, the manager of the hydropower facility, the Director of the Special Project Unit and the person responsible for sediment

[8] Raiffa et al., 2002 refers to the benefits of "full, open, truthful exchange" (FOTE) as an ideal in reaching better agreements within negotiation analysis.

[9] Sebenius (1992) provides a discussion of the tension between creating and creating value in negotiation analysis, and identifies what he terms the "negotiator's dilemma", in contrast to the Prisoner's dilemma.

[10] Our method is informed by two related approaches, namely: discourse-based approaches, including structured decision making, and Area Development Negotiations. The first approach involves the use of small groups of stakeholders' representatives to deliberate on relevant aspects of ecosystem services, bringing to the discussion their values, attitudes and beliefs, often using the steps of structured decision making (Gregory et al., 2012; McDaniels et al., 1999; Wilson and Howarth, 2002). The second approach includes a sequence of steps to build understanding of the case through interviews, focus groups, expert information and experiential encounters with the case study as a way to identify common strategies in the presence of divergent interests (Scholz and Tietje, 2002). The big difference is that in the work discussed here, the participants did not meet all together.

[11] http://www.jasec.co.cr/ambiente/manejo_cuencas.html.

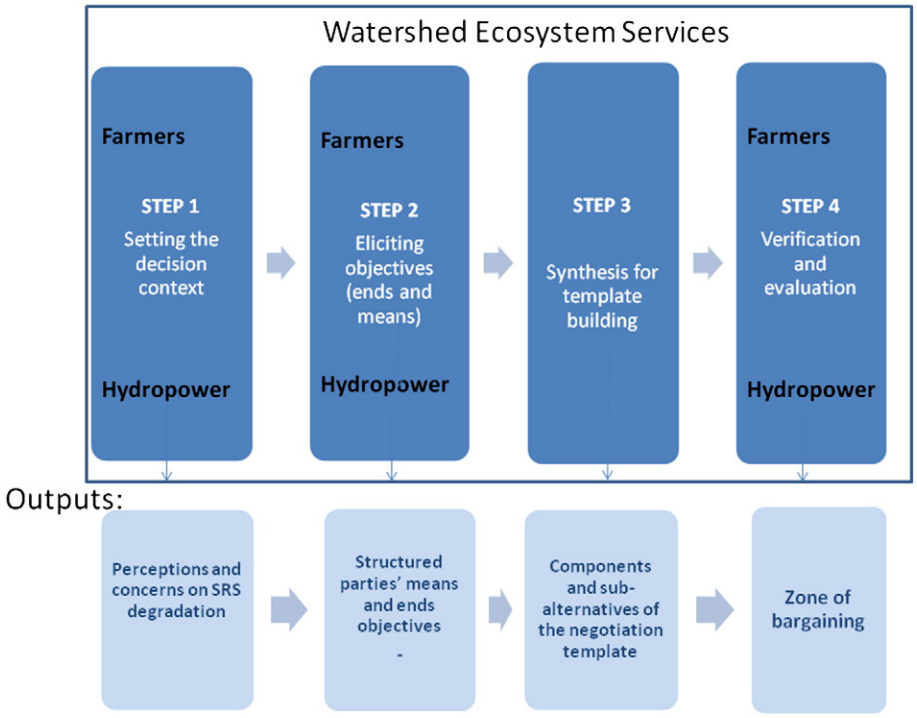

Fig. 1. Research steps to build the negotiation template.Note: numbers in the bottom-right (left) of boxes represent the percentage of votes given by JASEC (farmers) to that sub-alternative.

monitoring in the dam. We learned about i) system operations, ii) the effects of siltation on operations, iii) the utility's interests in respect to soil erosion in the watershed due to maintenance costs associated to landslides and eroded sediments affecting their pipelines and dam's storage capacity and, finally, iv) their institutional commitment to collaborate with other organizations in on-going and future initiatives to promote environmental awareness and implementation of soil conservation practices in the watershed. We also learned about the potential effects of uncertain future policy choices by government ministries about whether the utility's Water Tax payments may possibly be used to pay for watershed management investments, such as erosion control (Calvo, Pers. Comm., 2008).

4.3. Eliciting Objectives and the Means to Create an Ideal Mechanism (Step 2)

We ran separate group value elicitation sessions with representatives of the two groups who had knowledge of the production contexts and SRS degradation consequences (including 8 leaders of farmers' associations, for the farmers' meeting and 5 members of the JASEC operation and administrative board, for the hydroelectric meeting). In each of the two sessions we started by reviewing the decision content: the opportunity to create a soil conservation program, and current information regarding SRS degradation in the watershed (its causes and consequences for farmers and for the hydroelectric sector. Next, we explored past and on-going experiences regarding conservation of SRS and the alternatives that have been considered by farmers, in conjunction with incentives that would be helpful to foster their adoption. We then asked open-ended questions such as the following: i) What are the ideal outcomes for the design of a soil conservation program, (ii) What would be the indicators of a disastrous program, and iii) What are the pros and cons of possible actions that could comprise part of a soil conservation program. As one approach to spur thinking about what is needed in a mechanism to foster ES provision, we discussed the notion of the best possible or ideal, mechanism, and the components it would require, as addressed below. We also asked follow-up questions such as "Why is that important?" (referred to as the WITI test in Clemen and Reilly, 2001), a technique Keeney (1992) to help distinguishing among fundamental ends and means to achieve them. Following Kaplowitz and Hoehn (2001), the focus group discussions were transcribed to facilitate analysis.

We used the responses to questions as a basis to clarify the fundamental ends that matter for each party in designing a mechanism to foster soil conservation as well as means available to achieve those ends (de Groot and Hermans, 2009; Keeney, 1992; McDaniels et al., 2006). More specifically, fundamental objectives are the fundamental motivations for interest in the decision content at hand, while the means are important because of their implication for one or more of the fundamental objectives. For example, *targeting priority areas with high erosion* is a means to achieve the more fundamental objectives of *minimizing erosion* and *minimizing cost* of a soil conservation program in the watershed.

4.4. Synthesis for Building a Negotiation Template (Step 3)

In the discussions and interviews with each group, noted above, we touched on many aspects of alternatives that could be considered for design of a mechanism to encourage soil conservation, and alternatives for a soil conservation program itself. After the meetings, we distinguished among the ends and means, as discussed above, and used the ends objectives to provide the basis for creating potential alternative mechanisms (Gregory and Keeney, 1994). We also reviewed available literature regarding alternatives for soil conservation program design.

Step 2 then involved synthesizing the objectives and components of alternatives that should guide the negotiation into a negotiation template, which is similar to a multi-dimensional consequence table or objectives by alternatives matrix for a single decision maker (Hammond et al., 1999).

A first step is to develop a joint set of objectives that encompasses all major issues of concern for both parties. This step is akin to building an objectives hierarchy for a number of stakeholders (a task made more straightforward when guided by inclusion of the major concerns of both parties) (McDaniels et al., 1999). The next step was to use the means–ends discussions to identify the underlying

components needed to create sets of sub-alternatives. We identified four major components: *how farmers to participate in the program would be selected*, *the nature of the support they could receive*, *the nature of the agreement or contract*, *and which organizations should serve as the intermediaries on behalf of farmers*. The negotiation template then specifies various sub-alternatives under each of these for components, as the basis for creating overall alternatives for the design of a mechanism.[12] The focus on the components for creating new alternatives is crucial, because it is the variety and quality of alternatives that can lead to better outcomes (Raiffa et al., 2002). Following the example above, the means objective that seeks to *target high priority areas* implies the need for components of alternatives to consider how farmers would be selected to participate, and the alternative ways that parties could minimize erosion in the watershed.

4.5. Evaluation of Sub-alternatives under Each Component (Step 4)

An evaluation workshop was held with each of the two groups, separately, to verify and perform an initial evaluation of the acceptability of the alternatives to each of the two parties. We used a workbook structured with a page for each of the four broad components noted earlier, and their corresponding sub-alternatives (as shown in Table 1). We asked participants to first verify that the components and alternatives (which we interpreted from transcribed material of previous steps adequately captured their perspectives from those discussions) (Habron et al., 2004a, 2004b).

After verification by the two groups, the evaluation process is akin to eliciting the *zone of bargaining* (Raiffa et al., 2002) for each of the components.[13] The intent is to define the negotiation space, or areas of potential agreement among parties, that could help shape and direct the subsequent negotiation process. Members of each group were asked to identify which sub-alternatives under each of the four components would be acceptable from their viewpoint (a task similar to approval voting; McDaniels and Thomas, 1999). Then, participants in each group were asked to indicate which alternatives would be most preferred by them.

5. Results

5.1. Decision Context (Step 1)

In conducting the interviews with both groups, it became clear that several decision contexts are important in designing and implementing a program to enhance ecosystem service provision with erosion control. These include decisions about *designing the best possible mechanism* for an erosion control program, decisions about how *extensively and intensively such a program should be implemented,* and decisions about *whether individual farmers should participate* in such a program. All these contexts involve perspectives of both parties to these decisions, farmers and the electric utility. As an initial step in obtaining results, we diagrammed how each of these decision contexts relates to the others, and we diagrammed the objectives hierarchies (means–ends networks) for each party for several of these decision contexts. In order to save space, we do not present details of these diagrams for the various decision contexts. Instead, we focus only on the key decision context addressed here, the design of the best mechanism for fostering erosion control. In what follows, we provide text-based summaries of the perspectives of each party for this decision, rather than the detailed diagrams, to save space.

[12] This approach to creating alternatives from various sub-alternatives under each component is similar to building a *strategy table* in decision analysis (McNamee and Celona, 2001).

[13] Note that because the components are largely separable, they can be considered, evaluated and negotiated individually as part of an overall agreement.

Table 1
Components and alternatives of an ideal mechanism and their sources.

Component	Alternatives	Source
Selection of producers	All over the watershed	Both parties
	Bid through auctions	ES literature[a]
	High priority areas	Hydropower utility
	Socioeconomic status	Farmers
	Quasi-Random	Both parties
Nature of support	Credit	Farmers
	Reduced taxation on inputs	Farmers
	Technical assistance	Both parties
	Direct Payment	Both Parties
Nature of contract	Flexible	ES literature[b]
	Rigid	ES literature[b]
	None	Both parties
Who should be intermediary	Each single producer	Both parties
	Agricultural extension office	Both parties
	Watershed committee	Hydropower utility
	Producer's association	Both parties

Most information on alternatives proceed from parties' consultations, to increase the number of possible agreements ES literature we included selection- and contract-related alternatives suggested by literature.

[a] Ferraro, 2008.

[b] Bougherara and Ducos, 2006.

5.2. Objectives: Ends and Means for Designing the Ideal Mechanism (Step 2)

5.2.1. Farmers' Perspectives

Several themes recurred in our interviews and meetings with farmers. These included their perceived need to learn more about the technical or implementation aspects of adequate soil conservation practices and their concern about fairness in the treatment of different farmers in terms of the form of incentives (i.e. accounting for farmers' different needs and constraints). They also expressed various means to address these concerns, which could include building closer collaboration among farmers through intermediary organizations interested in mediating, monitoring and implementing the soil conservation program. They also mentioned the need for formal agreements among farmers and the program to ensure continuous support over time. Most of the alternatives mentioned by farmers during discussions were drawn from their present experience (i.e. soil erosion on their farms and in the watershed, PES schemes, technical assistance) and past experience (e.g. reduced input taxation and low-interest loans) with soil erosion control initiatives.

Our synthesis of the objectives of farmers, which was confirmed in subsequent meetings indicate that the characteristics of an ideal program include *i*) *ensuring fair distribution of opportunities and benefits among farmers* (which could be addressed in various ways), *ii*) *obtaining necessary support to implement soil conservation practices* (which could again be addressed in various ways, *iii*) learning about ways to implement soil conservation practices *iv*) *importance of some formal compromise/agreement between the program and farmers to keep with SRS conservation practices assumed,* and *v*) *participation to the program through intermediary organizations*. Many of the means for designing the ideal program relate to fundamental objective of achieving program success. In other words, one criterion for designing the mechanism is whether it is likely to achieve the fundamental ends of program implementation.[14]

5.2.2. Utility Perspectives

We found that JASEC's fundamental objectives (i.e. *minimize erosion in priority areas*) reflect their expressed concerns on how the degradation of Soil Regulation Services is affecting their production objectives and implies the need to *identify priority areas to target*

[14] Similar linkages between fundamental objectives for the process, and for the actual implementation, are found in Keeney et al., 1996.

program efforts. On the other side, *minimizing investment costs* indicate JASEC's concern with the efficient allocation of scarce resources (especially minimizing transaction costs associated to mediation, monitoring and enforcement of program implementation with individual farmers). Both these two fundamental objectives thus indicate the need for a soil conservation program to include targeting criteria (or a desirable component of a mechanism) for the efficient and effective selection of farmers that receive program support as well as the identification of organizations in existing governance structures that can help minimizing transaction costs for implementing and monitoring the program (i.e. they mentioned a possible alternatives the agricultural extension office or the watershed committee). Participants mentioned and discussed different types of support based on their knowledge of and experience with existing initiatives such as PES and technical assistance acknowledging the need to compensate and support farmers' efforts in SRS conservation. However, they felt that intermediary organizations were also needed to mediate formal agreements with farmers to effectively implement practices. A successful soil conservation program, moreover, would help JASEC meeting corporate responsibility and image (i.e. beyond the direct economic benefits derived from minimizing investments and erosion) as well as learning over time on how to improve its implementation. In other words, as with farmers, general components of a soil conservation program for JASEC's participants should include a strategy for selecting participants, the definition of type of support and incentive structure, the identification of organizations in existing governance structures to mediate and monitor program implementation with farmers, and providing learning over time on program implementation.

5.3. Synthesis for Building the Negotiation Template (Step 3)

The negotiation template comprises four components as shown in the left hand column of Table 1. The sub-alternatives available under each of the components are derived from views expressed by the two parties in nearly all cases, based on their experience regarding soil conservation. The two parties share most fundamental concerns and views on what components a desirable SCP should include, namely: *a means to select farmers, definition of type of support, creation of formal agreements among farmers and the program, and identification of desirable intermediary organizations*. This confluence of fundamental objectives and concerns in negotiation analysis is not unexpected, and it is helpful to structure the negotiation among parties (Sebenius, 1992). As shown in Table 1, we introduced three sub-alternatives (mentioned in literature on ES mechanism design) not mentioned by either party, but that enrich the possibilities available to them.

More specifically, the sub-alternatives under *Selection of producers* are based on the status-quo option of "*Quasi-random*" selection[15]; means expressed by farmers such as "*Selecting farmers by socioeconomic characteristics*" (i.e. to ensure program fair distribution of support) as well as on the ones expressed by JASEC concerning the concentration of program support in *High priority areas*. Here, we introduced the sub-alternative to select farmers by an auction–bidding process (Ferraro, 2008) as a way to increase economic efficiency of ES mechanisms by forcing farmers to reveal their opportunity cost. Similarly, for the component *Nature of support*, consultations with parties helped identifying means such as providing support for soil conservation practices from both farmers and JASEC, for which alternatives were mentioned such as removing taxes agricultural inputs or provision of low-interest loans for soil conservation practices, promote learning through technical assistance (i.e. to increase farmers' capacity and knowledge) as a status-quo alternative and *Direct payment*, following the existing PES scheme in the country.

The component *Nature of the contract* reflected parties' concerns with formalizing agreements to enforce continuous and reciprocal commitment of both parties. In this component the status-quo alternative for both parties is represented by no formal agreement (i.e. *No contract*). However, to enrich the alternatives available to parties we drew the two sub-alternatives labeled *Flexible* (defined annually) and *Rigid* contracts, from Bougherara and Ducos (2006). Finally, the alternatives for *Who should be intermediary* reflect the parties' fundamental concerns with ensuring adequate and legitimate mediation among farmers and the program through participation in and use of existing initiatives and key SRS governance actors.

Sub-alternatives under the component *Selection of farmers* and *Nature of support* are not mutually exclusive, and could be combined. For example, for *Selection of producers*, targeting farmers in priority areas prone to erosion and letting them compete through auctions could both be selected. Similarly, for *Nature of support*, providing *Direct payment* could be combined with *Technical assistance*. On the other hand, sub-alternatives are mutually exclusive under *Nature of contracts* and *Who should be intermediary*.

5.4. Evaluation of Alternative Strategies (Step 4)

These two sub-steps were conducted during two separate evaluation workshops with each of the parties. We first then presented the participants the results of previous consultations regarding the decision context and our synthesis of objectives and means to achieve them. We asked them to consider whether these summaries (conveyed in diagrams and text) could represent their party's concerns for an ideal mechanism. Both parties validated the findings as acceptably representing their party's fundamental concerns. Next, participants were provided a workbook of one page for each component and their respective sub-alternatives. For each component we asked participants to indicate which of the alternatives under each component would be acceptable (i.e. more than one sub-alternative could be selected), and which was most preferred, from their individual viewpoint. We ensured the questions were understood by all participants by having assistants help farmers who had more difficulty with the reading tasks. Fig. 2 summarizes the results of the evaluation process in a synthesis figure illustrating the *negotiation space* used in a previous study (Scholz et al., 2007). The figure shows alternatives acceptable to at least some of the farmers, to some representatives of JASEC, and to both. To avoid an arbitrary aggregation rule, we report the percentage of participants in agreement, in each box of the table.

Two of the sub-alternatives were not considered acceptable by either party: these are status-quo options, indicating the parties have a clear preference for change ("*no contrac*t" and "*quasi-random*" selection of farmers). The negotiation space (identified by the black colored boxes) identified during the evaluation phase show that the characteristics of a program desirable to both parties, and comprise the sub-alternatives that could serve as the focus of negotiations, because the percentages of support indicate relatively wider acceptance by both parties. Hence, the joint preferences indicate that such a soil conservation program could focus on *High priority areas* (more prone to erosion), promote *Technical assistance*, use either *Flexible* or *Rigid* contracts and entitle the *Agricultural extension office* or the not-yet-created *Watershed committee* as the intermediary between the program and the farmers.

These results hold some surprises. Farmers show low acceptance for covering the whole watershed in the program (i.e. they support concentrating in *High priority areas*). Similarly, monetary incentives such as *Credit* and *Removing Taxes on Inputs* or *Direct payment* (only partially acceptable partially by JASEC), have low acceptance among farmers. On the other side, farmers expressed low acceptance for selection mechanisms that promote competition among them such

[15] In many cases, past soil conservation initiatives in the watershed established explicit targeting criteria, although there has been no formal rule to direct resources only to priority areas. In effect, the programs have been available to those who wanted to participate.

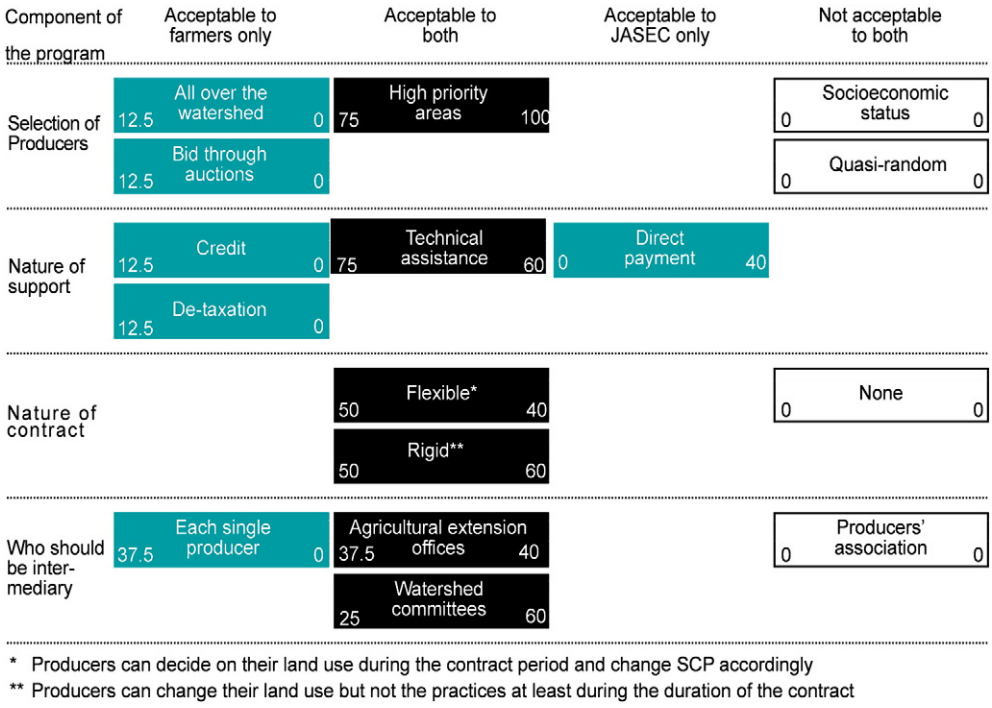

Fig. 2. Acceptable and most preferred alternatives for farmers and JASEC.

as *Bid through auctions*. For the component *Nature of the contract*, both parties' acceptance of both rigid and flexible contracts as sub-alternatives underlies a shared perception of the need to establish formal agreements among farmers and the program. It is interesting to note that sub-alternatives for intermediary entities both JASEC and farmers expressed preferences for *Agricultural extension office* or *Watershed committee* while none for farmers' associations.

Finally, after the evaluation exercise, both farmers and JASEC were asked to express their views on possible next steps in order to move forward this negotiation process. Both groups articulated the need to identify high risk areas, and better specify the nature of technical assistance sought by farmers. Moreover, both also indicated the need to create a structure for developing and implementing contracts, perhaps through a new watershed management process. Farmers also stressed the need to engage in the process other farmers especially within high-risk areas.

6. Discussion

Our application of negotiation analysis provides watershed conservation initiatives a complementary approach by focusing on creating negotiations among participants, which goes beyond a strict focus on availability and adequacy of financial incentives (McKenzie, 1997). The results show that concerns of parties regarding the key components of a soil conservation program are consistent with recent literature on the characteristics of PES schemes (Engel et al., 2008; Wunder et al., 2008). However, the negotiation analysis in this case study allowed us to identify several alternative approaches that can be built on areas of agreements among participants, and thus provide opportunities for building a more efficient, effective and fair soil conservation programs.

More specifically, the convergence of preferences of both farmers and JASEC on targeting high-risk areas provides an opportunity for increasing efficiency in hydrological ES schemes (Goldman et al., 2007; Parkhurst and Shogren, 2007). Consensus for *Technical assistance* highlights opportunities for the utility to help inform farmers understanding of what is possible and what is likely to work well through learning over time. This approach can mobilize scientific knowledge and appropriate technology, which are particularly important given that trends in extreme precipitation events might require continuous adjustments (Cash et al., 2003). Focusing on technical assistance can reduce search costs of technical information regarding soil conservation (Bekele and Drake, 2003; Cash, 2001; Vasquez and Santamaria, 1994). Consensus on the *Agricultural extension office* as a potential intermediary is consistent with the findings of Miranda et al. (2007), that in Costa Rica, third party — rather than direct-based intermediation is a key component of watershed conservation agreements among actors (Miranda et al., 2007).

Possible challenges to the application of this method in other contexts are related to characteristics of the ES under consideration and the specific decision-making contexts of stakeholders (Fisher et al., 2009). Future applications of the method should take into account specific barriers and opportunities that are defined by the type of ES under consideration. The specific case of ecosystem services provided in local contexts but used at global scale such as Climate-Regulation Services (CRS) (e.g. those regarding the debate on Reducing Emissions from Deforestation and Forest Degradation in the tropics (REDD+)) provides an example. Implementing negotiation analysis for CRS requires interactions among multiple actors operating at different scales and in different locations, and characterized by strong power asymmetry among the parties (Bierman, 2007; Wittneben, 2007; Wunder et al., 2008). Moreover, the potential for agreements among users and providers of CRS might be subject to considerable institutional mismatches given that the parties have divergent time-horizons and have access to different technical knowledge regarding costs and benefits of CRS (Cash and Moser, 2000).[16] Finally, actors involved in CRS provision typically live away from potential buyers and these two actors have, in most cases, little experience of direct interaction among them and might face high transaction costs. In this context, negotiations and mediation among providers and users of CRS are still needed (Sonnenfeld, 2008). Here, negotiation analysis

[16] Indeed, short-term horizons characterize small farmers' decision contexts regarding land use options as compared to the longer-term horizon of global actors interested in mitigating future climate change. In this case, the objectives of future generations should also be taken into account (Biermann, 2007).

could possibly focus on questions concerning i) the support-transfer modality, ii) how to select the seller and the buyers of carbon credits, iii) the identification of activities to be supported (O'Connors, 2008) and, finally, iv) the rules to guide multiple parties negotiations (e.g. legitimacy of intermediary organizations).

Finally, two potential institutional barriers to greater ES provision in the Birris watershed have become more apparent since this work was conducted. One barrier concerns the capacity of the ASA-Pacayas agricultural extension office. While both parties indicated the regional agricultural extension office would be an acceptable intermediary to help achieve agreements between the two parties, the office has experienced an ongoing lack of resources due to political and institutional factors. In the 1980s, the Government of Costa Rica adopted economic policies to reduce its aggregate public expenditures, thus also reducing budgets for agricultural extension offices, a change that still affects the agricultural extension efforts (Leclerc and Hall, 2007). Hence its capacity to play a new institutional role as outlined in this paper may be severely limited.

A second institutional barrier was noted in the introduction. Costa Rica electric utilities are striving to identify ways that their cash transfer for the Water Tax could return to them to pay for investments for watershed management where they use water resources for power production. The Water Tax has been in place since 2006 but its performance is hindered by institutional tensions between public users of water-related services (e.g. major hydropower companies) and public organizations responsible of redistributing resources generated by the Water Tax. Decisions regarding distribution of Water Tax funds respond to priorities set by National policies (Borges, 2009), in which watershed management by utilities do not get much attention. Hence, utilities at present are allowed to treat the costs of silt management and power replacement as legitimate costs that fall within their regulated rate base, but the costs of watershed management to avoid siltation are borne by the utility. Not unexpectedly, the national electric utility has decided to reduce its watershed management efforts in the Birris basin. Both of these points indicate the crucial importance of institutional resources to help address governance for climate adaptation, and the crucial role of broader policies in setting a favorable context for enhancing ES.

7. Conclusions

This article showed how value-based negotiation analysis can help identifying innovative alternative strategies acceptable to parties directly interested to soil conservation. The location of our case study can provide insights on negotiations for ES context that might be relevant for other developing countries where conservation of ES involves multiple actors and objectives. The application of negotiation analysis to other ES contexts (concerning larger scales and number of actors) could help identify potentials for joint gains among parties although it should consider the challenges of higher transaction costs, legitimacy of mediation and power asymmetry among parties.

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