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The importance of social drivers in the resilient provision of ecosystem services

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ABSTRACT

While a sustained flow of ecosystem services brings tangible benefits to humans, some ecosystem states and suites of services may be more desired by some people than others. Allocating or using the flow of services is loaded with asymmetries, complex power dynamics and political struggles between groups of people. We argue that the issues associated with such allocation and use questions are poorly integrated into the literatures of resilience, sustainability, and vulnerability. To illustrate this, we focus on three socially constructed factors that inhibit a fuller understanding about how to sustain the flow of ecosystem services: (1) rigidity/poverty traps; (2) power asymmetries; and (3) scientization of policy/politicization of science. These factors limit our ability to assess the sustainable flows of ecosystem services, and in particular to better understand the trade-offs and limits to aggregate human activity. We demonstrate that an improved understanding of the allocation trade-offs and limits to the flows of ecosystem services could result from more applied research that integrates the developing fields of deliberative democracy, pragmatic environmental philosophy, and legitimacy and rule compliance. Without the understanding that such integration would bring, researchers and policy makers risk underestimating the limits on flows of ecosystem services and how to accomplish their provision toward the greater collective – rather than individual – good.

1. Introduction

A long history of failures by traditional top-down management approaches, premised on static or linear notions of ecosystems and social organization, has prompted scientists and policy makers to consider alternative ways to perceive and manage the environment (Holling and Meffe, 1996). Concurrently, the increased scientific recognition of the complex and adaptive nature of the human–environmental system has led to the development of new theoretical approaches based upon more dynamic and holistic models (Armitage, 2008; Liu et al., 2007; Ostrom, 2007). New applied fields have emerged that explicitly seek to inform managers and policy makers such as resilience thinking (Berkes et al., 2000; Walker and Salt, 2006), sustainability science (Kates et al., 2001; Clark and Dickson, 2003), and vulnerability studies (Adger, 1999; Turner et al., 2003). Much of this research has moved beyond the dichotomous separation of social and ecological systems, toward studying coupled or linked social–ecological systems. These new fields incorporate greater attention to the existence of multiple possible ecosystem states, linkages across and among scales, and the idea that some ecosystem states at specific scales are more 'desirable' than others.

Large research endeavors into linked social–ecological systems have recently focused on natural capital and the provision of desired bundles of 'ecosystem services' to fulfill human well-being (Mooney and Ehrlich, 1997; MA, 2005), where ecosystem services are simply any and all benefits that people derive from ecosystems (MA, 2005). While initially focused on reducing environmental degradation in developing countries, the ecosystem service concept is now widely used (Norgaard, 2010). This is not surprising considering that human interventions in ecosystem processes are unsustainable in more than 60% of ecosystems (MA, 2005), that we now exceed planetary boundaries for a range of essential Earth-system processes (Rockström et al., 2009), and that degradation of ecosystem services directly impacts human health (Myers and Patz, 2009). In trying to understand potential solutions, the fields of resilience, sustainability, and vulnerability are theoretically coherent and offer appealing goals. However, there is an inherent danger that these approaches to understanding the human–environment nexus do not fully incorporate the social mechanisms by which governance and institutions accomplish those goals.

Groups of scientists or politicians have usually *a priori* decided on a 'desired' ecosystem state that will produce some 'desirable'

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mix and magnitude of ecosystem services in a particular place at a particular time. In other words, a bundle of ecosystem services reflects an inherent valuation of a specific set of services by specific groups of people at particular times and places, and either explicitly, or not, includes the inherent trade-offs that accompany those choices. Consequently, Carpenter et al. (2001) cautions that resilience of such a chosen set of services is a "normative concept;" and Armitage and Johnson (2006, 14) urge that consideration of resilience under such circumstances should be "situated in the context of contested and evolving human interests and the uncertainties of human interaction." Ultimately, the sustainability of ecosystem services is a distributional question, a matter of justice within and between generations (Norgaard, 2010).

Distributional questions may relate to trade-offs among different ecosystem services or to trade-offs among those people who achieve access to ecosystem services, and those groups that are precluded. Maximizing one ecosystem service can result in substantial decline in the provision of others (Bennett et al., 2009). For example, maximizing timber production over short time frames may greatly reduce regulatory services such as carbon storage or soil retention. Rodriguez et al. (2006) describe how human preferences usually prioritize provisioning services over regulating services, and both of these are prioritized over cultural and supporting services. The conclusion of work focusing on such trade-offs is the need to find a balance among services – to err on production and allocation of services to accomplish the 'greater good' (e.g., Nelson et al., 2009; Palumbi et al., 2009).

While trade-offs among services are relatively well described, resolving those that manifest as distributional issues between groups of people still challenge applied researchers and policy makers. Even considering widely desired goals such as sustaining the flows of ecosystem services, poverty alleviation, and environmental health, trade-offs among such goals may still persist. The Reducing Emissions from Deforestation and forest Degradation in developing countries (REDD) offers an example of a program seeking to balance trade-offs through economic means, with wide ecosystem service benefits that transcend climatic services to other services including biodiversity conservation, watershed protection, and pollination (Malhi et al., 2008). However, even here, intergenerational considerations are problematic; such programs can also be viewed as benefiting developed nations by decoupling feedbacks of continued, and perhaps unsustainable global economic growth through the use of ecosystem services in poor countries (Norgaard, 2010). Long-term repercussions of such trade-offs are poorly documented in many circumstances, particularly as they relate to leakage/externalities and the impacts to human health and wellbeing (Myers and Patz, 2009).

The normative issues associated with the distributional choices among ecosystem services at different scales, or how to cope with the intended and unintended consequences of those decisions is not new, and has challenged societies for millennia. Flyvbjerg (2001) describes how Aristotle saw a need to encompass a wider purview of knowledge than provided by analytical, scientific knowledge (*episteme*) and technical knowledge or know-how (*techne*); he pointed toward the need to incorporate *phronesis* – a need for prudence or practical wisdom when implementing management actions, which Flyvbjerg perceives as still unresolved, and which we address here.

2. Outline of argument

We take the normative stance that the broad principles advocated by the fields of resilience, sustainability, and vulnerability (e.g., improving capacity to adapt, reducing vulnerability to crises, creating more sustainable patterns of resource usage), are widely accepted as desired goals. These fields therefore offer a promise of more sustainable and equitable configurations of human–environment relationships than those used in the past. Nevertheless, these fields need to better integrate with the social sciences in order to explore the limits to the flow of ecosystem services and distributional trade-offs. In particular, they may benefit from research by political theorists, philosophers, and political ecologists. By doing so scientists may better "contribute to society's practical rationality in elucidating where we are, where we want to go, and what is desirable according to diverse sets of values and interests" (Flyvbjerg, 2001: 167).

In this manuscript, we illustrate how 'agency' and 'collective action' of both powerful and disenfranchised actors in a system affect the ability of humans to insulate themselves from the direct impact of degradation in flow of ecosystem services and to adequately document that degradation.[1] Through political processes, actors decide if the status quo justifies change. If the status quo is satisfactory, there is no problem for politics to resolve. However, if the status quo concerning flow of ecosystem services is perceived as, or becomes problematic, we ask what the constraints are to changing the system. Next, we consider how asymmetries among groups of people can lead to processes of overt or covert resistance that destabilize or transform a system. Finally, we recognize the political nature of information required to inform such decisions. Conceptually, our three focal research areas correspond respectively, to the political factors that strengthen or maintain the stabilizing (negative) feedbacks that preserve a specific state, the destabilizing (positive) feedbacks from the disenfranchised in decisions that tend to disrupt a specific state, and the use of science and politics to bolster specific feedbacks.[2]

After describing the three socially constructed factors affecting the governance of ecosystem services, we look to the social sciences for insights on how to address them. We focus on deliberative democratic theory, pragmatic philosophy, and legitimacy and rule compliance. Each of these fields explores the interaction across groups of people, the "irreducible pluralism in the world we encounter" (Parker, 1995: 25) or what Ostrom et al. (1999) simply terms "cultural diversity challenges."

3. Socially produced factors affecting flows of ecosystem services

3.1. Political and social constraints on changing the current system

3.1.1. Current asymmetries are protected by rigidity traps

Within any social–ecological system, institutions (i.e. informal and formal norms and rules of behavior) are mechanisms by which humans attempt to shape the incentives and constraints governing their interactions with each other and the natural world (Ostrom, 2005). Institutions include markets, rules, laws, norms, taboos and religious edicts. Once in place, institutions are often intractable ('sticky') and path dependent (North, 1990), creating institutional inertia that is difficult to pull apart or change course (World Bank, 2010). In resilience thinking, if institutions tend to remain highly connected, self-reinforcing, and inflexible despite changing circumstances, they create "rigidity traps," which limits the ability of actors within the system to re-organize interactions, even if such a reorganization would benefit the provision of ecosystem services to society overall (Gunderson and Holling, 2002).

Examples of rigidity traps include established property rights or sovereignty claims within sub-systems that limit collective action

[1] The disenfranchised are those in positions of less power in situations where power dynamics lead to improving the resilience/robustness of some members of society at the expense of increasing the vulnerability of others.

[2] Top-down stabilizing and bottom-up destabilizing forces reflect the Panarchy model (Gunderson and Holling, 2002).

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at large enough scales to protect ecological processes. Here, domestic legislative committees may wield disproportionate amounts of power in determining whether or not a state ratifies international treaties or attains agreed-upon goals (Barrett, 2003; Levin, 2010). Other traps include "sunk cost" investments that encourage, or at least lead to the continued unsustainable use of specific services (Janssen et al., 2003); constitutions that fragment landscapes along ethnic or religious borders; totemization of specific species or habitats such as marine mammals and wilderness where existence values are held above other human needs or desires (Cronon, 1996; Freeman and Kreuter, 1994); religious or cultural practices that require use of scarce resources (e.g., rhino horns; Worthen, 2005); policy processes and fragmentation that impede timely policy responses to new information or changing conditions (Sabatier and Jenkins-Smith, 1999), and those that favor reaching crisis conditions due to the production of revenue via insurance or subsidies (Munro and Sumaila, 2002). Although some level of rigidity is useful, and perhaps essential for providing structure to society (maintaining values, reducing injustices, and fostering resilience to short-term changes), rigidity may also result in overconsumption, or force trades-offs that may become maladaptive over time.

Rigidity traps are related to the concept of 'robustness', or in this case, the maintenance of a desired set of ecosystem services in the face of social–ecological system fluctuations (Anderies et al., 2004). Scholars have shown that in complex systems, robustness, often depicted as the converse of vulnerability (Gallopin, 2006), is not universally achievable; rather there are trade-offs between robustness, vulnerability, and performance (Anderies et al., 2007). Distinguishing between robustness and rigidity traps is not inherently clear in resilience thinking, as a rigidity trap from one perspective can represent another's robustness – imagine the scenario when the disturbance to which a system is robust is not an exogenous force, but rather internal actors attempting to reorganize the system from within. Homer-Dixon (1999) illustrates numerous cases of resource capture where robust elites marginalize specific groups, often along ethnic lines, encompassing both their ability to act and to report on their position. Even in democracies, the assumption that the majority view is representative of minority interests may be altogether fictitious (Guinier, 1994). Whether the system is robust or in a rigidity trap is dependent upon perceptions of what constitutes, and who decides on a 'desirable' system state.

An alternative line of literature describes the agency of the disenfranchised. Rather than the conventional wisdom that it is the powerful alone that seek to maintain the current system configuration, many authors demonstrate reasons why the disenfranchised may use their own agency in a manner that avoids change – either through deliberate disengagement of citizens from the state such as through migration to remote areas (Scott, 1985, 1998); or using the current political system to their own advantage such as described by Sahlins (1999).

To successfully maintain long-term flows of ecosystem services, institutions must remain responsive to the problems that they were designed to address, while avoiding rigidity traps, or risk remaining maladaptively robust as the flow of ecosystem services diminish.

3.1.2. Current asymmetries are protected by poverty traps

In contrast to rigidity traps that result from self-reinforcing processes and high connectivity, poverty traps develop under conditions of low connectivity. Examples of factors that can maintain poverty traps with respect to ecosystem services include hunger, water supply, disease, poverty, population growth, environmental degradation, and poor governance (Sanchez et al., 2007; Enfors and Gordon, 2008; Bonds et al., 2009). Poverty traps may require outside intervention, possibly through redirecting ecosystem services to alleviate constraining conditions. Poverty traps may be deliberately imposed or perpetuated within subsystems (based on attributes such as location, gender, class, ethnicity, or identity) through a variety of strategies of exploitation, repression, or deliberate avoidance by powerful elites that limit either documentation or repercussions from the marginalized.

Mitigation of global greenhouse gas emissions through capture of forest resources in developing countries by more powerful countries may perpetuate poverty traps or create them as a collateral repercussion of not wishing to bear the economic burden of emission reductions (Dow et al., 2006). These patterns mirror situations where intervention by powerful majorities (e.g., governments and international non-government organizations) in biodiversity conservation sought to impose conservation on developing countries (Adams et al., 2004). However, deficits in democratic processes hinder local mobilization of institutional resources to monitor and respond to negative externalities that these efforts may produce (Carpenter and Brock, 2008). Poverty, hunger, and weak institutions may then be exacerbated by exclusion from use of forest resources, leading to further environmental and social degradation by those illegally using resources, using alternate resources, or who are displaced to surrounding areas (Schmidt-Soltau, 2005). Under such circumstances, blame and responsibility can pass on to local peoples and away from the broader underlying issues driving the reductions in flows of ecosystem services.

To be successful at maintaining the long-term flow of ecosystem services, institutions must respond to threats (such as carbon emissions), but avoid producing or perpetuating poverty traps that are treated as externalities to certain groups. Otherwise, the long-term effectiveness of mitigation may be limited due to the inherent self-reinforcing dynamics associated with a poverty trap that, apart from obvious justice issues, result in continued environmental degradation.

3.2. Responding to emergent asymmetries

3.2.1. Asymmetries result in destabilizing feedbacks

At a landscape level, there are implicit trade-offs in selecting a specific configuration of ecosystem services, because different groups of people benefit to greater or lesser extents. As in all complex systems, there is no optimal level of provisioned ecosystem services, no real-world Pareto frontier (Levin, 2002). Issues of equity and justice can be balanced to varying degrees, but not optimized due to their normative nature. The resultant discord between achieving a specific combination of ecosystem services and a particular mix of ecosystem services that are desired by individuals, communities, or society in general, produces asymmetric gaps between what is desired and what is achieved (Lasswell and Kaplan, 1950).

Often the desired allocation or prioritization of ecosystem services at one level or scale may be radically opposed at another. For instance, the provision of wild meats in tropical forests at a local level may be essential for communities, but be counter to global biodiversity goals; swidden agriculture may sustain local economic or nutritional needs, but minimize global climate mitigation actions; and laissez faire planning and urban sprawl may benefit local governments, but work against global goals for the reduction of fossil fuel consumption. Asymmetries may be accentuated by differing worldviews or cultures.

Conflict between individual and societal goals leads to collective outcome dilemmas, at the heart of all political struggles. Such conflicts can occur between individuals, households, communities, states, and nations. Asymmetries emerge due to previous differences, power inequalities and political dynamics

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between multiple elite groups in a polyarchy (Dahl, 1961). Self-perpetuating cycles of path dependence can further reinforce these asymmetric relations. The repercussion of inequalities may be deliberately disruptive agency by the disenfranchised, which can precipitate regime shifts in dominant paradigms (as opposed to agency of the powerful that sought to maintain a system configuration, or where the disenfranchised lacked the capacity to instigate change as described in the previous section).

Vulnerabilities resulting from different worldviews regarding access to ecosystem services, property rights, and sovereign boundaries have resulted in conflict from colonial expansion around the globe over the past four centuries. Numerous cases of rebellion, revolution, and war by the disenfranchised illustrate when systemic costs of the current system configuration exceed marginal benefits (Scott, 1985, 1998; Homer-Dixon, 1999; Le Billon, 2001). For instance, post-independence India nationalized forests for control and export despite vibrant social–ecological systems dependent upon forest resources. This control was eventually dismantled by social movements and community groups as they sought to reclaim access to their local community forests (Poffenberger and McGean, 1996). Similar rebellion has happened throughout the developing world as a result of perceived and real constraints on access to flows of ecosystem services (Fabricius and de Wet, 2002). In some cases local residents have destroyed wildlife and habitat to eliminate the threat of outside interest in a specific ecosystem service impinging on their access to local resources (Brandon, 1998).

The recent interest in Reduced Emissions from Deforestation and Degradation in Developing Countries (REDD) may provide some avenues to accomplish both preservation and development. However, investment is needed to directly subsidize those disadvantaged in conjunction with the transaction costs of maintaining the desired set of ecosystem services (Coase, 1960). Benefits will need to reach the individuals and groups making decisions about forest use within the targeted forests such as Amazonia, rather than being absorbed by administrative processes alone (Pagiola et al., 2005; Malhi et al., 2008). Otherwise their agency, perhaps to avoid poverty traps, may undermine global desires for specific forest ecosystem services. Furthermore, the emerging recognition of human migration when ecosystem services become insufficient or unavailable to local inhabitants (REDD is not seen as a poverty alleviation program; Pagiola et al., 2005) add new and dynamic challenges with respect to displaced repercussions elsewhere (Warner, 2010). As environmental policies tighten millions of environmental refugees may be produced; in India alone, 4 million people may face eviction following amendments to protected-area policies (Brockington et al., 2006).

To be successful at maintaining the long-term flow of ecosystem services, institutions that remove people's access to, or use of a specific service, need to more explicitly attend to what these people will do if they have the capacity and agency to adapt or buffer that scarcity.

3.3. Avoiding scientization and politicization

3.3.1. Asymmetries and feedbacks can be masked by scientization and politicization

Inherent in the political debate used to promote the maintenance of, or alternatively the transition to specific ecosystem states, actors often employ a façade that attempts to mask true intentions, or to hide repercussions. The definition and framing of problems is central to the process of deliberating policy change. Different actors may use their own agency to manipulate both the policy process and the definition of problems to benefit their specific goals, favoring the status quo. Seekers of change must provide new compelling reasons for the inevitable 'tragic choices' that may contradict deeply held values and beliefs of some citizens that come with new system configurations (Calabresi and Bobbitt, 1978).

Science is commonly viewed as the search for truth, while politics represents bounded conflict (Lee, 1993). Early understandings of the relationship between science and politics assumed a linear model, that is, scientists equip politicians with unbiased evidence to inform decision making in a manner that ultimately benefits society (Jasanoff and Martello, 2004). Over the past few decades however, scholars have challenged this linear model, and instead have engaged in rigorous discourse of when the line between science and politics becomes blurred. Scientization uses science to *mask* one's interests (when politics become scientific), while politicization uses science to *fit* one's interests (when science becomes political).

The "scientization of politics" (Habermas, 1970) is commonplace in technocratic decision-making, in which scientific experts are empowered to make 'technically correct' decisions for resource management. Sarewitz (2004) illustrates the scientization of politics when he writes that "political debate permits the mobilization of a broad range of weaponry, including scientific facts, religious dogma, cultural norms, and personal experience, in defense of one's values and interests. But scientized debate must suppress the *open* discussion of value preferences; were it not to do so it would have no claim to distinction from politics." Scientization defers debate away from the tragic choices that encompass competing values, the production of winners and losers, and recognition that the flow of ecosystem services is bounded. Scientization can insulate decision makers at higher levels from accountability to on-the-ground realities (such as poverty and hunger), and delegitimizes those without a scientific perspective to support their position, thus marginalizing those unable to speak such a specialized language, which often includes the disenfranchised (Gismondi and Richardson, 1991; Lemos, 2003; Chapin et al., 2006). This limits the scope of deliberation, which is seen by many as essential to effective governance of ecosystem services.

Politicization is when people manipulate science to fit their desired political interests. Politicians are not the only actors that can politicize science, as scientists can also use science to defend and pursue their own political interests (Pielke, 2004). The issue of climate change in the United States is frequently highlighted as the epitome of recent science politicization, where competing interests use models, statistics, and evidence or uncertainty differently to support the outcomes they desire. This leads to a polarized political debate in the name of 'science', which in the United States, has resulted in continuous calls for more information and science to bolster the respective arguments. As with scientization, politicization can inhibit feedbacks because scientific studies that suggest fixing asymmetries are not acted upon by policymakers. Likewise, selective use of scientific information can result in deleterious effects of a policy being ignored, such as through the production or perpetuation of poverty traps.

The very existence of scientization and politicization does not necessarily preclude us from addressing asymmetries and feedbacks. Rather, our tendency to overlook or separate science and policy prevents us from taking advantage of these social phenomena (i.e., the important interplay between science, politics, and society that can result in deliberation, consensus, and progress). Sarewitz (1996) illustrates the in-exclusivity between science and politics, by presenting five myths of the science-policy interface: the myth of infinite benefit (that more science leads to more public good), the myth of unfettered research (that basic research will automatically yield societal benefits), the myth of accountability (peer review and reproducibility of results adequately hold science accountable), the myth of authoritativeness (science is objective and can resolve political disputes), and the

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myth of the endless frontier (new knowledge is autonomous from its moral and practical consequences in society).

The implications of these myths is that (a) proliferation of science will not automatically yield more sustainable, resilient, or less vulnerable systems, because flows of ecosystem services are bounded by the inherent capacity of ecosystems to produce them; (b) underlying values and overarching politics will influence what scientists choose to research, what funders choose to finance, and which studies are viewed as relevant and credible; and (c) sustainability, resilience, or vulnerability scientists by nature are engaging in a political process, which links their research to broader discourses on values, beliefs, and worldviews. Whether we like it or not, scientific knowledge is and will continue to be shaped to fit various (often competing) agendas. These three points illustrate that resilience, vulnerability, and sustainability science are an integral part of an often overlooked complex social process, wherein science interacts with values, beliefs, worldviews, and politics.

4. The benefits of wider deliberation

Ecosystem service outcomes are a function of balancing competing 'desires' that result from asymmetries, leading some to get closer to their desired goals than others. As we have shown, agency of those in power to self-allocate the flow of ecosystem services may lead to them maintaining their short-term benefits under a status-quo scenario. However, suboptimal outcomes for specific actors, particularly where seen as unjust, may lead to revolt against their current circumstances. We have argued for the need to explicitly acknowledge (1) traps that foster the status quo; (2) potential system destabilization as the disenfranchised revolt against current institutions; and (3) the use (and misuse) of knowledge and information to support individual rather than collective goals.

Norgaard (2010) emphasizes the original intent of an ecosystem services approach was to increase awareness about how collectively we were living beyond our means. Walker et al. (2009) suggest new institutions are needed, and Lemos and Agrawal (2006) urge that those institutions focus on limits. Ignoring the feedbacks we describe will restrict efforts to adequately document the full scope of unsustainable use of ecosystem services, and to inform the development of new and more equitable institutions. Seeking solutions, we argue for more robust attention to deliberative democratic processes, the philosophical underpinnings of decision-making, and the factors affecting rule legitimacy and compliance.

4.1. Deliberative democracy

Deliberative democratic processes are widely seen as a means to achieve ecosystem service goals across geopolitical or cultural differences. Through more pluralistic approaches, procedural justice, legitimacy, and trust-building, deliberative processes might help to reshape norms and values, and alleviate some negative feedbacks maintaining maladaptive states or positive feedbacks against top-down imposition of rules. However, while consensus on ecosystem service provision may be an ideal outcome of deliberation, Wheatley (2003) expresses concerns about how well trans-cultural deliberative spaces can achieve consensus, which is regarded by some as central to the deliberative process (c.f., Jürgen Habermas; Thompson, 2008). Nevertheless, other theorists perceive such 'agonistic' deliberative processes (cf. Mouffe, 1999) where consensus is not reached, as beneficial due to the process of open debate, sharing of information, and better awareness of local needs. In other words, the means are often as important as the ends (see also Scott, 1998).

By deliberately developing social learning platforms, policy makers may foster more democratic governance by requiring actors to participate in defining the services of interest, examining the drivers of change, and discovering differential vulnerability among actors. Over time, social learning has been linked to a questioning of the values that underpin institutions and decision-making (Keen et al., 2005) and therefore could provide social feedback on the appropriateness of different forms of governance. It is this sort of social, or political, feedback that is credited with transforming democratic institutions toward protecting the less powerful (Thelen, 2003).

However, in locations with little or no prior experience with democracy, and with low capacity to protect less-powerful resource users, "participatory" approaches may weaken existing social networks and ecosystem services through corruption or rent-seeking by elites (Blaikie, 2006). In cases such as these, donor countries would need to appraise and sometimes protect local institutions and interests as a critical component of new initiatives, or reconsider interventions altogether.

The political economy of involving resources users was an important factor in the recent trend away from centralized power in governing natural resources. Negotiating locally legitimate rules within a decentralized governance approach offers opportunities for greater democratic participation by groups that would have been disenfranchised under top-down policies (as suggested by Ribot, 2003), while benefiting state authorities under fiscal pressures to ensure the continued flow of ecosystem services. Although deliberation offers opportunities for greater legitimacy, high transaction costs, persistent injustices and the impossibility of neutral facilitation pose contradictions to the possibilities of accommodating the interests of all groups (Wollenberg et al., 2001; Robards and Lovecraft, 2010). In addition, under some of the new REDD initiatives, despite promises of participatory democratic governance; the profound environmental threat posed by climate change has renewed calls for re-centralizing resource management (Phelps et al., 2010). However, by ensuring at least the existence of locally accountable representation with discretionary powers in decisions over local ecosystem services, Ribot (2003) suggests success is more likely to be achieved.

Creative solutions to conflicts between indigenous groups and federal agencies provide examples of such processes of deliberation with consensus. For example, the Canadian government and the Council of the Haida Nation agreed to disagree on such fundamental issues as the legitimacy of land title within the Gwaii Haanas National Park Reserve and Haida Heritage Site in northwest British Columbia (Hawkes, 1996). In Australia, co-management research has demonstrated that an acceptance of ambiguity in outcomes, but commitment to a process of deliberation, can move government and indigenous partners toward mutually desired goals (Nursey-Bray and Rist, 2009). Ecosystem service councils at different levels (including trans-boundary) and watershed management groups have also provided opportunities to deliberate beyond single issues, single perspectives, and disjointed political boundaries. So-called "grey zones" in international law where countries accept that jurisdiction is unresolved represent a similar concept.

Irrespective of the promise of accomplishing "mutual interest" through deliberation, special privileges may be needed to protect marginalized groups (such as women or ethnic minorities) from the wishes of the majority or powerful. Within the international community, less powerful states may also need new tools to enforce agreements against the more powerful states. For example, Mexico has not received their agreed-upon water allocation from the Colorado River, despite a negotiated trans-boundary agreement with the United States (López-Hoffman et al., 2010). Such circumstances may require a more pragmatic approach to deliberation.

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4.2. Pragmatism

Despite the inherently social questions about provision of ecosystem services, Norton (2007) describes a "deplorable lack of appropriate conceptual tools for discussing environmental problems that usually encompass several scales of time and space." Norton (2005) draws on pragmatism (cf. Charles Sanders Peirce, John Dewey), a field of philosophical thought that emphasizes the need for diverse groups of people to actively come together in the public sphere, present their demands, offer their insights, and hammer out their differences (Parker, 1995). Norton's emphasis on pragmatism supports a move away from a singular use of economic evaluation for ecosystem services to a greater sense of shared responsibility through pluralistic deliberation, informed by a plurality of experiences toward a common good (i.e., of all human life and culture). Pluralism recognizes that there are "genuine differences among moral situations, because there are many kinds of entities and possible relations among them. These situations involve a significant variety of values, and hence of kinds of conflict to be resolved" (Parker, 1995: 32).

Seeking solutions, Nowotny et al. (2002) call for a socially robust science where ethics provides a process of greater open deliberation about the limits of scientific inquiry as it relates to environmental decision-making in a pluralistic and dynamic commons. Parker (1995: 24) sees pragmatism as a means to address uncertainty by developing an analysis of reality that both makes sense of experience at multiple scales and does not overstep the bounds of knowledge legitimately derived from experience. Collectively these authors find common ground and mirror emerging consensus elsewhere (Fischer et al., 2007; Jentoft, 2006) that a pluralistic deliberative process is necessary within the scientific academy and among society in general. Such processes lay the "groundwork for a social and political philosophy that places democratic and humanitarian concerns at the center of social arrangements" (Parker, 1995: 25).

Science-policy models that attempt to embrace these concepts, such as co-production of science and policy and interactive research, fall under the umbrella of 'mode-2 science;' multi-and-interdisciplinary action-oriented research (Gibbons et al., 1994; Scott et al., 1999; Lemos and Morehouse, 2005). These models are critiqued by some as tarnished with ideology and politics (Hessels and van Lente, 2008), but we see them as potential avenues for addressing the misuse of information to accomplish individual rather than collective goals, as they are deliberately designed with the notion that management-oriented or applied science and politics are not mutually exclusive endeavors.

4.3. Legitimacy and compliance

While open or perhaps philosophical debate is needed to improve local legitimacy of rule development and incentives for compliance, better attention is also needed about the conditions that encourage collective action against rules. This is fundamental to ensuring that rules are monitored and effectively enforced. There are incentives to cheat when broad rules governing ecosystem services do not reflect practical needs on the ground, and are thus perceived as illegitimate or unachievable. The emerging literatures on factors that affect local collective action against imposed rules are providing valuable insights (in conjunction to the factors that promote self-organization and development of local rules with conservation benefits). These literatures include natural resource enforcement and compliance, corruption, poaching, and what are termed "folk crimes" where illegal activities are locally sanctioned (e.g. Tyler, 1990; Skonhoft and Solstad, 1996). Intermediate-level lack of accountability through corruption or avoidance in reporting or enforcement by state agents seeking to appease both their superiors and their constituents (Robbins, 2000; Laurance, 2004), or illicit use of local services (Robbins et al., 2009) provide opportunities for research into human agency. Insights from these research efforts include understanding the importance of rationality assumptions (Keane et al., 2008), the need for better efforts to curb bribery by multinational corporations in the developing world (Laurance, 2004), and recognition that irrespective of formal rules, it is frequently the "negotiations of local state authorities with local people that determine actual conservation rules-in-use" (Robbins et al., 2009). Consequently, understanding legitimacy and compliance offers avenues to assess the practical outcomes of deliberations (open and philosophical, or not), and the causal factors that encouraging collective action or agency detrimental to the sustained flow of ecosystem services.

5. Conclusion

The flow of ecosystem services is finite (Walker et al., 2009). Consequently, there is a need to work toward restraint in human use of ecosystems. To do so requires the need to incorporate knowledge about "limits on aggregate levels of human activities" (Lemos and Agrawal, 2006). Norgaard (2010) notes that "while economists have been unusually successful at averting the ethical questions, and in the process supporting those who currently benefit from the governance structure, this avoidance has become central to the problems we now have in reaching a global accord." The three processes we describe provide examples of what is being avoided and why. Where the flow of ecosystem services cannot fulfill all social and ecosystem needs, the feedbacks we discuss will need to be integrated into governance institutions to ensure that the resilience of ecosystem services is not incrementally eroded, with long-term repercussions for human or ecosystem health.

Openly deliberative processes may better incorporate feedbacks from the marginalized, but will require the more powerful to incorporate pluralistic local needs and values into the dominant paradigms that they seek to maintain. For example, constitutions favoring equal opportunity of all citizens may limit their ability to provide preferential allocation of resources to specific groups or communities.

Establishing the degree that global desires are being achieved in the context of local repercussions will better illuminate priorities for action. Numerous authors have indicated that biodiversity goals in the tropics will not be met without addressing poverty first (e.g., Adams et al., 2004). By better understanding feedbacks associated with poverty traps and local agency, the degree of restraint needed by the more powerful may be described and potentially responded to. For example, balancing mitigation of climate emissions through REDD in developing countries should not mask the need for comprehensive reductions in carbon emissions by largest emitters, or exacerbate poverty, which is inextricably linked to resource access in many regions. Ignoring that linkage ignores the full cost of our carbon emissions.

More fully deliberating the 'desirability' of ecosystem services in social–ecological systems can not only balance competing conceptualizations of 'desirability', but can build further benefits toward sustainability or resilience of ecosystem services. Such benefits include the two-way reshaping of worldviews to build trust and collective identities between opposing interests. It is here that long-standing philosophical debates can be drawn upon in a process of social learning, as we collectively seek to find legitimate sustainable relationships with each other and the world around us. Indeed, as Levin (2010: 13) concludes "one of the great challenges in achieving sustainability will be in understanding the basis for cooperation." Without such a *phronetic* approach, society will

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struggle to develop a long-term strategy whereby we collectively live within the inevitable limits of the globe's ecosystems.

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