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Political ecological perspectives on socioecological relations

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Abstract – This paper highlights the major political ecological perspectives in the Anglophone literature on socioecological relations with emphasis on three main theoretical framings: environmental/social dialectic; environmental constructivism; and the co-production of socionature. These framings resonate with the literature's conceptualization of nature-society relations in terms of the destruction, construction, and co-production of nature. The paper discusses the ontological and epistemological foundations of each perspective, their main methodological approaches, and the signature theoretical contributions to understanding socioecological relations. Case studies illustrate the thematic and theoretical orientation of each perspective. In the conclusion we highlight some of the common theoretical threads that connect these perspectives, notably their dialectical approaches, an emphasis on power relations, the notion that ecology is a social relation, and an emphasis on the nonequilibrium character of socioecological systems.

Mots-clés :
political ecology ; relations socioécologiques ; dialectique environnement/société ; constructivisme environnemental ; coproduction de l'ordre naturel et de l'ordre social

Résumé – Trois approches des relations socioécologiques par la *political ecology*[1]. À partir de la littérature anglophone, cet article met en lumière les principaux points de vue de la *political ecology* sur les relations socioécologiques. Il explore en particulier trois cadres théoriques : la dialectique environnement/société, le constructivisme environnemental et la coproduction de l'ordre naturel et de l'ordre social. Ces cadres entrent en résonance avec la conceptualisation, dans la littérature anglophone, des relations nature-société en termes de destruction, construction et coproduction de la nature (Robbins, 2012). L'article aborde les fondements ontologiques et épistémologiques de chacun des trois points de vue, leurs approches méthodologiques principales et leurs contributions théoriques propres pour comprendre les relations socioécologiques. Des études de cas illustrent les orientations thématiques et théoriques de chaque point de vue. La dialectique société/environnement explique les changements environnementaux (par exemple, l'érosion des sols) et la vulnérabilité à la variabilité (par exemple, les sécheresses, les chocs économiques sur les marchés) à travers les relations sociales de production et d'échange. Ce point de vue combine une approche structuraliste de la société avec une approche

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Voir, dans ce même numéro, les autres contributions au dossier « À propos des relations natures/sociétés » : le texte d'introduction de Xavier Arnauld de Sartre, Bernard Hubert et François Bousquet, le texte de Michael Schoon et Sander van der Leeuw et le texte de Patrick Caron.

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positiviste de l'écologie. Ce sont les travaux de l'économie politique critique sur la dégradation des sols et la famine dans les Suds qui en sont les meilleurs représentants (Watts, 1983b ; Blaikie, 1985). Sa base de théorie sociale prend racine dans le matérialisme historique, notamment dans les études néomarxistes sur le (sous-)développement. Cette approche d'économie politique de la dynamique des changements environnementaux prend appui sur le concept d'équilibre qui dominait l'écologie jusque dans les années 1980. C'est dans les années 1990 que les *political ecologists* qui travaillaient sur la dialectique environnement/société ont commencé à intégrer l'idée de déséquilibre écologique dans leurs analyses. Le point de vue sur le constructivisme environnemental s'est construit dans un cadre post-structuraliste des questions environnement/société. Les tenants de cette approche défendent l'idée que les récits sur le changement environnemental (par exemple, la disparition de la forêt en Afrique de l'Ouest) renforcent le savoir dominant qui légitime à son tour les relations de pouvoir (Fairhead et Leach, 1996). Ces récits prennent typiquement la forme d'histoires qui réduisent la complexité des relations de cause à effet, désignent un coupable, légitiment une expertise et stabilisent des processus biophysiques incertains (Forsyth et Walker, 2008). Ces récits renforcent les pouvoirs dominants mais suscitent de nombreuses critiques. Ainsi, beaucoup d'études analysent les discours pour montrer comment les savoirs sur l'environnement et l'ordre social sont coproduits (Foucault, 1980 ; Hajer, 1995). La coproduction des ordres sociaux et naturels est le point de vue le plus récent en *political ecology* pour étudier les interactions entre les relations socioécologiques. Son fondement théorique prend appui sur deux traditions de recherches pluridisciplinaires : les *science and technology studies* et la théorie de l'acteur-réseau. Trois cadres conceptuels caractérisent cette approche des faits socioenvironnementaux : (1) la connaissance scientifique est une pratique à la fois sociale et culturelle (Pickering, 1992) ; (2) les objectifs et les actions des scientifiques modèlent ceux des acteurs politiques et vice-versa (Braun, 2000 ; Jasanoff, 2004) ; (3) les processus non humains et biophysiques sont parties prenantes des relations socioenvironnementales (Latour, 2005). Les thématiques et le cœur théorique de ces trois approches étaient initialement centrés sur les conséquences néfastes des forces économiques et politiques sur l'environnement. Le point de vue adopté désormais est plus constructiviste, au sens où il met davantage l'accent sur les processus de coproduction ; il repose sur une vision discursive et réticulaire des relations socioécologiques (Robbins, 2012 ; Castree, 2014). Par ailleurs, ces trois principales approches prennent part, à des degrés divers, aux débats contemporains qui traversent l'écologie scientifique. Les points communs entre ces trois points de vue sont leurs approches dialectiques, l'importance donnée aux relations de pouvoir, l'idée que l'écologie est avant tout un rapport social, et enfin l'accent porté sur le caractère non équilibré des écosystèmes. Ensemble, ces différences et points communs quant à la conceptualisation des relations socioécologiques illustrent la vitalité de la *political ecology* et la diversité des théories sociales et écologiques ; vitalité et diversité qui caractérisent cette approche transdisciplinaire de la nature, de la science et de la société.

Introduction

Political ecology refers to a diversity of theoretical and methodological approaches to socioecological relations that share a common interest in questions related to the politics of natural resource management, access, and control, environmental knowledge, and their interactive effects on livelihoods and environmental change dynamics. This paper highlights the major political ecological perspectives in the Anglophone literature on how nature-society relations have been conceptualized with emphasis on three main theoretical framings: (1) the environmental/social dialectic; (2) the environmental constructivism; and (3) the co-production of socionature. All three frameworks stem from critiques of how nature-society relations are theorized in explanations of diverse human-environmental problems and their solutions. Whether inspired by the reductionism of neo-Malthusian explanations of land degradation or by critiques of the notion of land degradation itself, these theoretical perspectives and related research methods illustrate the engagement of political ecologists with fundamental ontological and epistemological issues that characterize nature-society debates.

Political ecology emerged in the 1970s and early 1980s in the context of political economic critiques of cultural ecology and systems ecology. The critique basically argued that to explain environmental degradation (e.g. soil erosion) one had to situate resource management practices, typically of smallholders in the developing world, within the broader political economy (Watts, 1983a; Blaikie, 1985). This fusion of political economic and cultural ecological perspectives became known in Anglophone geography as political ecology (Blaikie and Brookfield, 1987; Bassett, 1988). The political ecological critique, initially influenced by Marxist agrarian studies, gave rise to a succession of conceptualizations of nature-society interactions. Paul Robbins identifies three distinct theoretical approaches to nature-society relations in the political ecology literature which he terms the "destruction", "production", and "co-production" of nature (Robbins, 2012). This paper builds upon Robbins's chronological but also ontological and epistemological discussion by highlighting how society and nature are

conceptualized in the political ecology literature over the past thirty years. This short review is by no means exhaustive. And it should not be interpreted as a summary of paradigmatic shifts, as if one framework was abandoned in favor of another. Rather, it is better to view the diverse conceptualizations as co-existing, even today, in political ecological research. In the conclusion we summarize some of the major similarities and differences in these theoretical frameworks with the hope that readers will decide in the context of their own research which socioecological conceptualization advances understanding.

The environmental/social dialectic

The environmental/social dialectic explains environmental change (e.g. soil erosion) and vulnerability to variability (e.g. drought; market shocks) in relation to the social relations of production and exchange. This perspective combines a structuralist view of society with a positivist view of ecology. It is best represented by the political economic critiques of land degradation and famine in the global South (Watts, 1983b; Blaikie, 1985). The social theoretical basis of this framing draws on historical materialist perspectives, notably neo-Marxist (under)development studies. For example, both Blaikie and Watts draw upon Bernstein's notion of the "simple reproduction squeeze" to theorize the political economy of soil erosion in Africa and South Asia (Bernstein, 1978). This concept refers to the processes in which farmers and pastoralists mine soils or overgraze pastures because of their dependence on commodity production (e.g. cotton or livestock sales) to meet the basic needs of household reproduction. In times of deteriorating terms of trade, when the price of inputs increases but market prices for smallholder products remain the same or decline, smallholders overuse resources despite their knowledge that this will lead to reduced productivity. Environmental degradation occurs as a result of these combined political economic and ecological processes. Degraded soils in turn contribute to the process of impoverishment as a result of declining yields. In contrast to the classic or colonial approach to land degradation and society, which blames land users for being backward and irrational and overpopulation as the main causes of environmental problems (Blaikie, 1985, p. 53-60), scholars drawing on the environmental/social dialectic perspective view smallholder behavior as quite rational under adverse political-economic conditions.

More recently, this political economic critique has engaged with research in positivist ecology that questions the notion that ecological systems return to a single "benchmark" or "steady state" (Zimmerer, 2000). New ecology, or nonequilibrium ecology, is characterized by analyses of land degradation that are conscious of the scale-dependency (spatial and temporal) of environmental degradation (Turner, 1993; Grabbatin and Rossi, 2012). The amount of "degradation" perceived is always relative to a baseline condition that will vary as the spatial and temporal boundaries of ecological analyses change (Behnke *et al.*, 1993; Scoones, 1995). The environmental/social dialectic literature in political ecology incorporated nonequilibrium ecological ideas into their analyses as part of their critique of states and aid donors whose models and interventions are based on equilibrium assumptions about the biophysical world. For example, states and aid donors promote "new enclosure movements" to combat environmental degradation by implementing territorial conservation strategies that are intended to contain and manage environmental degradation (Zimmerer, 2000). However, these territorial strategies often fail to improve landscapes and livelihoods of resource users because they misdiagnose the temporal and spatial dimensions of environmental change dynamics (Turner, 1993; Zimmerer, 2000). The "*gestion de terroirs villageois*" approach is a classic example. Its advocates promote land use zoning as a solution to perceived land degradation and land use conflicts (Turner, 1999). In semi-arid areas of West Africa, this confinement of land use activities to specific zones (agricultural zone, pastoral zone) restricts the ability of mobile pastoralists to take advantage of temporally and spatially shifting rangeland resources. Reduced pastoral mobility within the confines of "*gestion de terroirs villageois*" zones can lead to rangeland degradation, reduced herd productivity, and increased farmer-herder conflicts (Turner, 1999).

Research methods in the environmental/social dialectic tradition combines existing scientific studies of land degradation (e.g. soil nutrient loss, bush encroachment) with household surveys of farming systems and household budgets. The focus of analysis centers on causal explanations driving smallholder decision making to overwork the land. Explanations typically emphasize processes that link resource users to broader political economies through "chains of explanation" (Blaikie and Brookfield, 1987). These multi-scale analyses place emphasis on the social relations of production and exchange within households and communities and the role of the state and other actors (e.g. merchants) in perpetuating underdevelopment. In summary, the hallmark of this political economy approach to socioecological relations is its dialectical framing of "environmental problems" in which, as Blaikie put it:

> "environmental degradation is seen as a *result* of underdevelopment (of poverty, inequality and exploitation), a *symptom* of underdevelopment, and a *cause* of underdevelopment (contributing to a failure to produce, invest and improve productivity)" (Blaikie, 1985, p. 9; emphasis in original).

The environmental constructivist approach

Environmental constructivist perspectives build upon post-structural framings of environment-society questions. This approach argues that accounts of environmental change (e.g. forest loss in West Africa) legitimize knowledge claims about socioecological relations that simultaneously legitimize power relations (Fairhead and Leach, 1996). These accounts typically take the form of stories that simplify complex cause and effect relationships, assign blame, establish expertise, and stabilize uncertain biophysical processes (Forsyth and Walker, 2008). Environmental narratives tend to reinforce authority rather than be authoritative. Many studies draw on discourse analysis to show how environmental knowledge and social order are co-produced (Foucault, 1980; Hajer, 1995).

James Fairhead and Melissa Leach's work on environmental change narratives of West Africa's tropical forests illustrates this second political ecological perspective on socioecological relations. Their book, *Misreading the African landscape*, reveals that state foresters in Guinea have misread landscape history, particularly forest cover (Fairhead and Leach, 1996). Foresters perceive the mosaic of forest islands at the transition between the tropical rain forest and humid savanna as remnants of a more extensive tropical forest. Influenced by the desertification theories of French colonial scientists (Aubréville, 1949), Guinean foresters blamed smallholders for destroying the forest and imposed draconian measures (prison terms, fines) to prevent further forest loss. Fairhead and Leach challenge this narrative and policy by reconstructing the environmental history of the forest-savanna mosaic. Their reading of 19th century travel narratives combined with interdisciplinary field research and the analysis of aerial photographs and satellite images suggested an alternative reading of landscape history. The forest islands, they argued, rather than representing relicts of an historically more extensive forest, were actually expanding as a result of socioecological relations, notably tree planting and reforestation associated with changing fire regimes. Their counternarrative of forest expansion challenged state foresters' understandings of nature-society relations and landscape history, which for a variety of intellectual and political reasons have remained remarkably resistent to such critiques.

The environmental constructivist approach in political ecology is more recently advanced by Tim Forsyth and Andrew Walker in their work on the politics of environmental knowledge in northern Thailand. Like Fairhead and Leach, they confront environmental crisis discourses and their framings by questioning the scientific validity of representations of environmental change, in this case upland deforestation and downstream flooding and water shortages. Drawing on Hajer (1995), they show how scientific knowledge and the framing of environmental problems are tightly intertwined through the process of "problem closure" (Forsyth and Walker, 2008, p. 12). They examine the links between expertise, problem closure, and the stabilization of certain ideas that subsequently become incorporated into environmental narratives. Like Fairhead and Leach, they demonstrate how this process of environmental explanation typically excludes "local" understandings of biophysical processes to the detriment of both scientific understanding and land users who are commonly punished for their resource management practices.

Forsyth and Walker's work demonstrates how dominant environmental narratives often depend on simplified characterizations of ecological systems that are far more complex and uncertain than assumed. On the one hand, states and aid donors are attracted to nature-society simplifications because they provide relatively easy management rules (Turner, 1993). The "steady state" narrative helps to justify the "restoration" of and intervention in an ecological process that is assumed to be preventing the return of a "normal state" (Zimmerer, 2000; Grabbatin and Rossi, 2012; Scoones, 1999). Ironically, such (mis)representations of environmental change legitimate state and aid donor interventions on the grounds that only they have the authority and expertise to manage environment-society problems. Forsyth and Walker argue that the state (and aid donors) (re)produce themselves in the process of problem closure, policy making and implementation. The challenge, they argue, is to show how environmental narratives simplify and

> "stabilize complex and uncertain processes of environment change; reflect, and reinforce different social orders by being based on particular valuations or experiences… [reflect] particular notions of expertise; and particular sets of ideas about which social groups should carry the burden of blame and responsibility… In other words, environmental knowledge and social order are coproduced" (Forsyth and Walker, 2008, p. 18).

The goals of environmental constructivist approaches are not simply to deconstruct narratives and to propose counternarratives. The objectives are to advance scientific understanding of biophysical changes and to open up this analytical process to actors like smallholders whose experience and understanding have historically been undervalued. This emphasis on popular participation in environmental governance links political ecology to institutional approaches that emphasize democratic institutions, transparency, and accountability in natural resource management (Chhatre and Saberwal, 2006; Forsyth 2011; Ribot, 2007).

Multiple research methods are required to achieve this pluralistic understanding of socioecological processes

and environmental history. Historical methods include archival research, the reading of travelers' and scientific accounts as well as policy documents and aid donor reports, and the analysis of historical aerial photographs and maps (Fairhead and Leach, 1996, p. 16). Field methods encompass residing in communities, participant observation, focus group and key informant interviews, collecting oral histories, interviewing policy makers in various ministries and donor organizations, and collaborating with other researchers organized into interdisciplinary teams to conduct biophysical as well as social science research. Reconciling conflicting interpretations and "reading accounts both 'in' and 'out' of their contexts" is necessary throughout the research process (Fairhead and Leach, 1996, p. 16).

The co-production of socionature

The co-production of socionature is the most recent political-ecological approach to examine the interplay of socioecological relations. The theoretical foundation of this approach builds upon two multi-disciplinary research traditions: Science and Technology Studies (STS) and Actor-Network Theory (ANT). Three theoretical frameworks characterize this approach to socionatural research: (1) scientific knowledge is a form of social and cultural practice (Pickering, 1992); (2) the goals and conduct of scientists and political actors shape and are shaped by one another (Braun, 2000; Jasanoff, 2004); and (3) nonhumans and biophysical processes actively participate in socioecological relationships (Latour, 2005).

The first two of these three theoretical frameworks are rooted in Science and Technology Studies (STS) and the related field of the Sociology of Scientific Knowledge (SSK). Scholars working in these fields emphasize the socio-cultural dimensions of the production and reproduction of scientific knowledge (Jasanoff, 2004). A crosscutting theme of these frameworks is that scientific knowledge is a culturally and politically-mediated representation of the material world (Pickering, 1992; Jasanoff, 2004).

Political ecologists initially gave little attention to the first theoretical framework (that scientific knowledge is a form of social and cultural practice). However, this changed as geographers working in the subfield of critical physical geography began to explore the construction of scientific authority in relation to political-economic forces (Lave, 2011). The motivation stems from the observation that "the same political economic forces that set the conditions for the resource conflicts we study also shape the conditions of production of the environmental science that plays such a crucial role in those conflicts" (Lave, 2012, p. 366).

The proliferation of markets in ecosystem services has also motivated political ecologists to investigate how ecological principles are applied in market-like settings. In his research on compensatory wetland mitigation programs in the United States, Robertson (2004; 2006) shows that the use of rapid ecological assessment methods to assess the potential economic value of wetlands hinges on the experience of individuals using the identification tools. That is, the rapid ecological assessment method is far from being a purely technical and objective way to evaluate the economic value of plants. In short, representations of the economic value in plants (i.e. natural objects) depends on the way that scientific data are created and mobilized in varied social settings and hence should be regarded as a "social achievement" (Robertson, 2004).

The second theoretical framework, that the goals and conduct of scientists and political actors shape and are shaped by one another, also informs political-ecological approaches to the study of socionatural complexes. Gabrielle Bouleau's (2014) case study of the scientific management of Seine and Rhône Rivers in France is a good demonstration of this perspective. Drawing upon Erik Swyngedouw's notion of the hydrosocial cycle (1999; 2004) and Sheila Jasanoff's (2004) conceptualization of co-production, Bouleau shows how the formation of watershed management plans in the Seine and Rhône Rivers basins can be attributed to the ways that scientists differentially framed and studied water problems in the two watersheds. Scientists working in the Seine River viewed it as a biogeochemical system that deserved targeted nitrogen and phosphorous load reduction strategies. In contrast, the Rhône River was characterized as a basin in which scientists considered the maintenance of fluvial geomorphological processes as necessary to sustain downstream biodiversity and habitat. Subsequently, managers in the Seine basin invested in bioreactors to mitigate ammonia levels, while managers in the Rhône watershed shelved a plan for dam construction in favor of a flood regime that provided ecological services downstream.

Unlike the first two theoretical frameworks of the co-production approach, the third explicitly borrows from Actor-Network Theory (ANT). ANT is a method and theory for studying socioecological relations that requires the researcher to closely "follow the actors" in order to explain the unfolding of socioecological processes (Latour, 2005). Here socioecological relations are produced by both human and nonhuman actors. Thus, for Latour (2005), frying an egg on a cast iron skillet is the outcome of the actions of the skillet as it is of the person who chose to cook the egg. Castree (2002) summarizes Latour's arguments as one in which nonhuman objects do not merely "sit" there, but instead act as

"quasi-objects" to alter the behavior of humans and other nonhumans (Latour, 2005).

In practice few political ecologists fully adopt Latour's (2005) stance that nonhumans are "fully fledged actors" (Castree, 2002; Kirsch and Mitchell, 2004). While many political ecologists recognize that the biophysical properties of objects are important, they generally reject the view that nonhumans have agency in any "equal" way to undergirding structures such as capitalism (Kirsch and Mitchell, 2004). Hence, political ecologists, specifically those who study natural resource management and urban ecologies, draw attention to the ways that the biophysical properties of resources "resist," "assist," or "redirect" political economic prerogatives (Swyngedouw, 1999; Boyd *et al.*, 2001; Bakker and Bridge, 2006; Linton and Budds, 2014). A recurring theme of these studies emphasizes the importance of "being open" to the influences that the material world can have on social action. Pickering characterizes this human-nonhuman interaction as a "dance of agency" that is "embedded in a decentered and open-ended becoming of the human and nonhuman" (Pickering, 2010, p. 7). This means that as the behavior of the elements in an assemblage changes, so too does the character of the human-nonhuman relationship. Hence, there is no guarantee that deviation from an initial characteristic relationship can be "undone" or "returned to" because the future character of the relationship will depend on future behavior by humans and nonhumans (Pickering, 2010).

Two studies that demonstrate the third theoretical framework of the co-production approach are Paul Robbins' s *Lawn people* and Harold Perkins's (2007) study of American elm trees as a participant in the cycle of urban development and management. In his classic text, *The lawn people: how grasses, weeds, and chemicals make us who we are*, Robbins shows how in the process of making lawns, humans and nonhumans interact in ways that co-produce one another. The lawn people plant turf grass, which in turn subjects people to ceaseless mowing and toxic chemical applications. Robbins conceptualizes the lawn as a "sociotechnical system which produces a political and economic turfgrass subject…whose life is disciplined by the material demands of the landscapes they inherit, create, and maintain" (Robbins, 2007, xviii). His research reveals a certain anxiety among suburban lawn owners who, compelled by their neighbors, community, lawn chemical companies, and turfgrass itself, attend to the needs of their lawns and, in the process, make themselves into who they are, "lawn people."

In a different urban socioecological setting, Perkins (2007) combines Marxist political economy with ANT to elucidate the social and nonsocial labor required to produce urban forests. In keeping with Kirsch and Mitchell (2004), Perkins does not grant equal ontological status to both humans and nonhumans. Instead, he emphasizes that "the ontological priority [of the capitalist labor process] resides with social relations of production (including nature) that govern the interaction between humans and objects within a capitalist political economy" (2007, p. 1153). By conceptualizing elm trees as a form of nonhuman labor, Perkins is able to show "that nonhuman organisms can labor within capitalist environments, actively contributing to their form" (2007, p. 1154). In his case, urban forests require maintenance and upkeep by human laborers to "retain use, exchange and abstract values" (Perkins, 2007, p. 1155). Because of the manner in which elm trees grow (they quickly outcompete other plants) and their symbolic value in the American urban landscape, city managers across the country hired plant managers to respond to the growth of the elm tree. When Dutch elm disease reached the U.S. twice by way of shipping cargo boxes made out of infected wood, regulators responded by increasing labor requirements to try and ward off the spread of the disease and the demise of the American elm. This case is a good illustration of Pickering's idea that human-nonhuman relations are "open-ended" and "becoming" (Pickering, 2010). An entirely new "normal" commenced for the American elm tree because of the unexpected inclusion of Dutch elm disease into the fabric of the urban political ecological assemblage.

The co-production approach to socioecological research differs from the environmental/social dialectic and environmental constructivist approaches in two ways. First, co-production theory explicitly seeks to break ontological distinctions between science and society. From this perspective, scientific knowledge is not an independent form of knowledge production that is generated for the benefit of society; rather, scientific knowledge is produced within specific socio-cultural contexts and influences societal goals. This is different from approaches that only emphasize the ways that scientific knowledge legitimates the political agendas of the powerful and which do not interrogate scientific practices themselves or how scientific knowledge influences government policy (but see Davis, 2007). The implication of this theoretical framework is clear: "The production, circulation and application of science are deeply interconnected, so our analyses should be, too" (Lave, 2012, p. 366-367).

The second distinction between co-production theory and other socioecological perspectives is its focus on socioecological assemblages that are co-produced by both humans and nonhumans. Although co-production theory engages with representations and narratives of nature-society relations, it is distinguished by its attention to how natural properties re-direct socioecological assemblages. Together, these two theoretical contributions of co-production theory show how socioecological relations are constituted, how they are practiced, and

how their biophysical composition influences the directedness of socioecological relations across scales.

The methodological toolkit of co-production researchers varies by the theoretical approach taken. Methods common to the first two theoretical frameworks (scientific knowledge as practice and the mutual relationships between science and policy) include multi-sited participant observation and open-ended interviewing of scientists and bureaucrats over long periods (e.g. seasons, years, program periods, grant cycles) (Traweek, 1988; Robertson, 2010). Researchers typically study the scientific and policy research and writing processes, personal interactions, scientific reports, e-mails, and spatio-temporal arrangements of work places and meetings. Ethnographic methods like participant observation are particularly useful in understanding the meaning and behavior of scientific and bureaucratic activities.

Political-ecologists who study socioecological assemblages (i.e. the third co-production theoretical framework), combine social science methods common to the structural-dialectical and environmental constructivist approaches with positivist biophysical data collection methods and analytical techniques (Robbins, 2012). This research often includes direct or indirect measures that detect change in a biophysical process that can be identified as an influence on social relations. The biophysical method used will vary according to the biophysical process in question.

Conclusion

In summary, the conceptualization of socioecological relations has been variously viewed by Anglophone political ecologists. The thematic and theoretical focus of the main approaches have evolved from an initial emphasis on the destructive impacts of these relations on the environment and society from political economic framings to more constructivist and co-productionist perspectives that build upon discursive and network approaches to socioecological relations (Robbins, 2012; Castree, 2014). Moreover, these main approaches have differentially engaged with contemporary debates in ecological sciences. Common threads running through these political ecological perspectives are dialectical approaches, an emphasis on power relations, the notion that ecology is a social relation, and an emphasis on the nonequilibrium character of socioecological systems.

The dialectical perspective is most evident in the co-production framework in which socioecological assemblages are constituted by human and nonhuman interrelationships. But it is also central to the environmental/social dialectic in which smallholders ensnared in commodity relations mine soils to make ends meet. This socioecological process simultaneously impoverishes soils and producers who experience declining yields. Similarly, the dialectical view informs environmental constructivist approaches in which environmental narratives shape resource management policies which, in turn, produce unintended landscapes. The landscape becomes something else through its entanglement with environmental narratives.

Power relations at multiple scales figure importantly in all three socioecological perspectives discussed here. In the environmental/social dialectic, land degradation is most often associated with the precarious status of smallholders. Their (in)ability to negotiate higher prices for cash crops or secure greater access to productive resources is linked in part to their political power. Differential power relations also explain the dominance of certain environmental narratives and the inability of counternarratives to gain ground. The co-production framework is more cautious about the location of power (Robbins, 2012, p. 241). It remains a question rather than a presumption given the importance of the dialectical relationships shaping socioecological relations.

Each of the socioecological frameworks presented are based on the notion that ecology is a social relation. The words "socioecological" and "socionature" suggest that the status of the ecological is inextricably linked to the status of the social. Ecology is a social relation in the environmental/social dialectic perspective because of the dialectical nature of cause and effect relationships. Landscapes are "contained and are constituted by their relations to other things…they are always becoming something else, precisely through their relating" (Robbins, 2012). In the environmental constructivist approach, explanations of ecological change and what counts as "natural" are rooted in the social relations of production of discourses and expertise (Robbins, 2012). Ecology is a social relation for the co-production approach in two ways. First, scientific knowledge is "made possible by a certain discipline of 'ordering appearances' known as science…[which reproduces conventional] practices of creating and mobilizing specific ecological data" (Robertson, 2004, p. 365). Second, for those who borrow from ANT, the social world is the outcome of networks of relations forged between human and nonhuman actors. Ecology is constituted of and by a web of relations between humans and nonhumans that, in total, create the social world (Latour, 2005).

Nonequilibrium ecology informs each of the socioecological frameworks presented in this paper. Contrary to equilibrium notions that ecological systems trend toward a steady state, nonequilibrium ecology demonstrates that land degradation associated with environmental/social dialectics depends strongly on the scale of degradation analysis (Turner, 1993; Zimmerer, 2000). Nonequilibrium ecology is key to the environmental constructivist critiques of dominant environmental narratives that hinge

on simple cause and effect relationships. Counternarratives emphasize the complexity and uncertainty of ecological systems and thus challenge the command and control prescriptions of environmental policies and managers. Nonequilibrium ecology is theoretically analogous to co-production theories that draw from ANT. To ANT co-production, any ecological state is merely a temporary stabilization of human-nonhuman assemblages. ANT co-production emphasizes that socioecological relations are in flux and constantly "becoming" (Latour, 2005; Pickering, 2010).

Together, these similarities and differences in the conceptualization of socioecological relations illustrate the vitality of political ecology and the diversity of social and ecological theories that characterize this transdisciplinary approach to nature, science, and society.

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