Developing environmental governance research: the example of forest cover change studies

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SUMMARY

Environmental problems are often complex and it is widely recognized that they cannot be satisfactorily addressed by single disciplines. The review of forest cover change studies points to the need to carry out research integrating economic, political, social and environmental aspects. Existing interdisciplinary study areas, namely ecological economics, political ecology, sustainability science and Earth system governance do not yet fully integrate all the required aspects. This paper points out that the establishment of greater synergies between those study areas would be beneficial in developing the broader study area of environmental governance. A definition of environmental governance as a subject of study is developed. Lack of an all encompassing theory of environmental governance is highlighted, while the improbability of such a theory is acknowledged. In relation to normative work, the refinement of principles of good environmental governance could support the design and prioritization of policies. Empirical research needs to include the testing of hypotheses arising from theoretical developments, assessment of policy uptake and new exploratory research. Methodologically, environmental governance might start from an interdisciplinary approach followed by further integration leading to a transdisciplinary study area that uses a mixed methods research approach.

Keywords: deforestation, environmental governance, interdisciplinarity

INTRODUCTION

It is widely recognized that environmental problems are often complex and cannot be satisfactorily addressed by single disciplines, and interdisciplinary research in natural resource management is needed (see Redclift 1998; Fry 2001; Kinzig 2001; Mascia *et al.* 2003). This recognition has led to the integration of some disciplinary areas, such as ecology

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with economics, and to consideration of further integration with other disciplinary areas (for example Gale 1998). These positive developments are not yet as successful as hoped in relation to the breadth and scope of the required integration: the incomplete understanding of the nature of, and solutions to, environmental problems, as exemplified by the review of studies on deforestation and transition to reforestation presented later, demonstrates the need to further develop interdisciplinary environmental research. The question is: what type of interdisciplinary research is needed?

The review of forest cover change studies points to the need to carry out research that integrates economic, political, social and environmental aspects to better understand environmental problems and to design and implement appropriate measures to address them. We describe this type of research as environmental governance research.

There is no agreement about what constitutes environmental governance. For example, studies that have called for improved forest governance (Nepstad *et al.* 2002; Curran *et al.* 2004) implicitly assume that it is synonymous with a reduction in deforestation. However, there are trade-offs between the provision of local, national and global benefits from forests. In making decisions about the environment, states do consider the economic benefits of alternative resource use options (Hempel 1996). Unless economic considerations are excluded from the concept of governance, a state which has good governance may, therefore, choose to deforest certain areas if this decision yields national economic benefits greater than its costs, other things being equal. The following questions will therefore be addressed. How can environmental governance as a subject of study be defined? Is there an environmental governance theory? What could its methodology involve?

We first review forest cover change studies and existing interdisciplinary research areas because calls for interdisciplinary research need to substantiate the practical reasons for which it is being advocated (Bauer 1990). There are two reasons justifying this paper's argument for environmental governance research. Firstly, forests provide significant global biodiversity and climate-related benefits, however, deforestation continues at alarming rates in tropical and subtropical areas (FAO [Food and Agriculture Organization of the United Nations] 2006). Concern over the impacts of deforestation has led to the publication of hundreds of papers and books during the past four decades. Despite all

those efforts, there is still some uncertainty about the relative significance of the causes of deforestation, their influence on reforestation, and particularly over their significance for policy development. The review considers, therefore, key studies that have addressed economic (such as prices, labour and transport costs, human population and income exchange rate) and governance (for example democracy, property rights, corruption, illegal logging and political-bureaucratic factors) causes of deforestation and reforestation. These economic and governance factors need to be reconciled and their possible role in the transition from deforestation to reforestation clarified. To achieve that, interdisciplinary research as proposed here is needed.

Secondly, existing interdisciplinary study areas, namely ecological economics, political ecology, sustainability science and Earth system governance do not yet integrate the economic, political, social and environmental elements that are required to address complex environmental problems. This is not intended as a negative criticism of those study areas as there have been proposals for further integration, for example between ecological economics and political ecology (M'Gonigle 1999), and sustainability science scholars appear rather open to new disciplinary contributions (Komiyama & Takeuchi 2006). Rather, this paper seeks to build on their strength and points out that the establishment of greater synergies between those study areas would be beneficial.

The further development of environmental governance as a broader interdisciplinary study area, which may become transdisciplinary, is considered by addressing the questions raised above. It addresses issues about the definition of environmental governance, its theory and normative research, and concludes with a discussion of broad strands of empirical research and some methodological issues. There is already empirical work being carried out within the environmental governance area (Adger & Jordan 2009a; Delmas & Young 2009; Hendricks *et al.* 2009); it is beyond the scope of this paper to summarize it, or to present a detailed proposal for empirical environmental governance research in general, even though some research priorities are outlined, particularly in relation to forests.

Before proceeding, it is useful to define some key terms. 'Study area' is used to refer to an emerging area of research to differentiate it from an established academic discipline. An academic discipline is defined by shared ontology, epistemology and methodology, represented in its academic journals, learned societies, and academic departments or faculties to which its scholars belong. An academic discipline normally has sub-disciplines (Abbott 2001); for example, human geography and cartography are sub-disciplines of geography. Some of the interdisciplinary study areas considered later could be said to be disciplines given that they have a journal and a learned society (for example *Ecological Economics* and the International Society for Ecological Economics). However, they are referred to as study areas because there is debate among the relevant scholars about the state of their theory and methodology (see

Baumgärtner *et al.* 2008) and actual status as a discipline (Clark & Dickson 2003). Environmental governance is a new area of research with limited shared knowledge and methodology, even if it is already being formally taught (for example the undergraduate degree in Environmental Governance, University of Guelph; Master of Environmental Governance, University of Manchester; Master of Science in Environmental Governance, Freiburg University) and an academic journal has recently been renamed *Environmental Policy and Governance*. Environmental governance is therefore referred to as a study area.

Interdisciplinary also needs to be defined together with the related terms multidisciplinary and transdisciplinary, and we follow Jakobsen *et al.* (2004) and Wickson *et al.* (2006): (1) multidisciplinary research refers to the involvement of multiple disciplines using their own methodology without integration of knowledge; (2) interdisciplinary research involves the development of a common framework within which the different epistemologies are used to investigate an issue or different aspects of a problem; and (3) transdisciplinary research refers to the integration of different disciplinary ontologies, epistemologies and methodologies leading to the creation of shared knowledge.

DEFORESTATION AND REFORESTATION

Many developed and some developing countries saw their forest area decline in the initial stages of social and economic development, however it later stabilized before starting to increase over time (Mather 1992). This phenomenon has led to the development of the forest transition theory (Mather & Needle 1998), which is still being developed (Barbier *et al.* 2010; Lambin & Meyfroidt 2010). This theory needs to explain the causes of the initial decrease in forest area (the deforestation phase) and the subsequent stabilization and reforestation. The following sections address the economic and governance causes of deforestation and the possible factors leading to reforestation.

Economic causes of deforestation

From an economic perspective, deforestation is a process best explained by the values of alternative land uses. When land uses alternative to forests have higher values they replace the forest (Angelsen 2010; Barbier *et al.* 2010), and this is often the case in practice, with agriculture being the leading proximate cause of tropical deforestation (Geist & Lambin 2001; Foley *et al.* 2005). Several variables affect the profitability of the alternative land uses, including prices, labour costs, transport costs to markets and technology, which have been termed immediate causes of deforestation (Kaimowitz & Angelsen 1998). Higher agricultural commodity prices, lower wages and more roads commonly result in deforestation (Kaimowitz & Angelsen 1998). Higher agricultural prices may lead to increased demand for land to expand the production of agricultural products. Lower rural wages and lack of off-farm

employment may induce farmers to expand their agricultural activities. Roads increase the accessibility of forests and can lead to deforestation. However, in some cases roads may be built because an area has been cleared and settled, thus inverting the causal link (Kaimowitz & Angelsen 1998). The effects of agricultural input prices and technological change in agriculture vary. In relation to fertilizers, pesticides and farm implements, higher prices may lead to substitution of fertilizer by land, thus increasing deforestation, or they may reduce deforestation as a result of lower profitability of agriculture (Kaimowitz & Angelsen 1998; Angelsen & Kaimowitz 2001). Technological change may result in a decrease or increase in deforestation. Significant increases in deforestation do not result from labour-intensive technologies when labour is in short supply, or technologies that increase the productivity of lands already cultivated (Kaimowitz & Angelsen 1998; Angelsen & Kaimowitz 2001). Conversely, technologies that facilitate the expansion of agriculture in forested land are expected to lead to deforestation (Kaimowitz & Angelsen 1998; Angelsen & Kaimowitz 2001).

The profitability of logging, a forest land use, is affected by timber prices. However, their effects are uncertain and may depend on case specific factors. Some studies found that higher timber prices may lead to deforestation as a result of the higher profitability of logging, while other studies found that lower prices are a disincentive for efficient harvesting and processing technologies, thus leading to more logging (Kaimowitz & Angelsen 1998). Considering logging and agriculture as complementary land uses (the latter follows the former) increases the likelihood that higher timber prices will result in higher deforestation (Kaimowitz & Angelsen 1998). This suggestion obviously relates to lands that are suitable for agricultural development (including pastoral activities). Biophysical factors, for example fire proneness (Nepstad *et al.* 1999), can influence whether lands unsuitable for agriculture are deforested. Overall, the evidence on the profitability of sustainable forest management indicates that it cannot compete with agricultural land uses (Pearce *et al.* 2003).

The immediate causes are affected by underlying causes (Kaimowitz & Angelsen 1998), which include human population, income, exchange rate policy and public debt. The evidence on the effects of these variables is presented below by drawing on an earlier review (Kaimowitz & Angelsen 1998) and by considering the results of more recent econometric analyses. A caveat applies: the results of several econometric studies, including those summarized by Angelsen and Kaimowitz (1998), may have been affected by poor model specification, the use of inappropriate regression methods and lack of testing for autocorrelation (Nguyen Van & Azomahou 2007; Scrieciu 2007). The robustness of the results reported would need, therefore, to be assessed.

Population can drive deforestation through demand for agricultural land and products, fuelwood and timber, changes in labour markets and technological change (Kaimowitz & Angelsen 1998), but the empirical evidence on the actual effects of population is mixed. At the subnational level,

population density and growth were positively correlated, but the correlation did not hold when market access and soil quality were accounted for, while rural population density had a greater effect on deforestation when market access and off-farm opportunities were limited and land-ownership was more equally distributed (Kaimowitz & Angelsen 1998). The uncertainty about the influence of population on deforestation has not been resolved, at least in terms of the results from later econometric studies, which have found respectively that (1) population growth and density did not influence deforestation in Africa, Asia and Latin America (Koop & Tole 1999), (2) population growth and density influenced deforestation in Latin America and Africa but not in Asia (Bhattarai & Hammig 2001), and (3) population density (Nguyen Van & Azomahou 2007) and population growth (Barbier & Burgess 2001; Scrieciu 2007) were significant contributors to deforestation across Africa, Latin America and Asia. Historical evidence also shows that the increase in population was a key factor in providing the labour necessary to deforest large areas in Asia, America and Europe (Williams 2003).

Per person income levels have been associated with higher deforestation rates in developing countries (Kaimowitz & Angelsen 1998). Income can cause deforestation by creating demand for timber and agricultural commodities, but at later stages of development an increase in income could lead to a reduction in the deforestation rate, for example, by increasing the demand for the ecosystem services provided by forests. Empirical studies of this inverted U-shaped relationship, known as the Environmental Kuznets Curve (EKC), present evidence in support of the EKC (Copper & Griffith 1994; Barbier & Burgess 2001; Bhattarai & Hammig 2004) and against it (Shafik 1994; Koop & Tole 1999; Nguyen Van & Azomahou 2007). The specifications of the models and the statistical methods used have probably influenced the findings of those studies and need further attention (Nguyen Van & Azomahou 2007).

The real exchange rate is another macroeconomic variable that is thought to affect deforestation by influencing export prices: devaluation of a currency increases domestic export price of agricultural commodities thus increasing the demand for agricultural land. An earlier assessment did not find the exchange rate to be statistically significant (Bhattarai & Hammig 2001), but that result could also be due to the fact that the black market premium was used as a proxy because of lack of data on the real exchange rate. A recent study finds that a depreciation of the real exchange rate increases deforestation in developing countries (Arcand *et al.* 2008).

Another variable that has often been included in explanatory models of deforestation is external debt, but the empirical evidence has been inconclusive (Kaimowitz & Angelsen 1998). It was thought that debt could influence deforestation if it resulted in greater emphasis on the exploitation of forest resources to increase government revenues to pay interest and repay the capital. However, there is no strong theoretical reason to expect that debt would influence deforestation because there are other government

expenditures that could have effects similar to those of interest repayments (Scrieciu 2007).

Governance and deforestation

At the highest governance level, democracy has been shown to result in lower deforestation because authoritarian governments make investment decisions to conserve a forest more risky and insecure, and hence lead to greater deforestation (Deacon 1994; Didia 1997; Mather & Needle 1999; Bhattarai & Hammig 2001; Nguyen Van & Azomahou 2007). That finding is corroborated by another study, which finds political stability to be statistically significant for the full sample of countries, but to be significant only for Latin America when regional models are assessed (Barbier & Burgess 2001). However, deforestation is also likely to occur in democracies given that those regimes are subject to local pressures and are reluctant to enforce forest protection (Shafik 1994), a point also made in the context of decentralized governance (Tacconi 2007a).

Property rights is another governance variable that has been shown to be related to deforestation (for example see Deacon 1994). Insecure property rights over forests increase the profitability of extractive activities such as logging and may stimulate conversion to agriculture (Barbier *et al.* 2010). However, increased security of property rights can also lead to deforestation if it increases the net present value of land clearing (Angelsen 2010). The relationship between property rights and deforestation can therefore be summarized as follows. The most likely outcome of insecure property rights is deforestation given that there is no single agent who has an interest in conserving the forest; secure property rights may lead to deforestation or conservation, depending on right-holders' preferences and the incentives they face.

Corruption is a governance aspect that has received attention relatively recently due to reports of cases of corruption in the forest sector (see Contreras-Hermosilla 2000; Le Billon 2000; Smith *et al.* 2003a). Corruption could cause deforestation in several ways. For example, it may result in the allocation of ecologically significant forests to conversion instead of conservation, and facilitate the replacement of natural forests with plantations. Overlaps between production and conservation uses have been documented (for example see Wells *et al.* 1998), but there is a lack of knowledge about whether this was due to corrupt behaviour or to other causes, for example, poor coordination of activities between government officials. Overall, there is still uncertainty about the influence of corruption on deforestation. Two studies have found a significant statistical relationship between corruption and deforestation (Barbier & Burgess 2001; Barbier *et al.* 2005), while another study found that corruption was correlated with changes in total forest cover but not with changes in natural forest cover (Smith *et al.* 2003b). The problems associated with the data on corruption, including whether they measure perceived or experienced corruption

(Treisman 2007), imply that the effects of corruption on forest cover will need to be further assessed.

Illegal logging is another possible cause of deforestation that has been researched in recent years (see Tacconi 2007b). Illegal logging includes a range of illegal activities, such as the illegal acquisition of forest concessions, harvesting in protected areas, the illegal export of logs and the violation of financial regulations related to the forest sector. Illegal logging needs to be considered in the broader context of whether a country is still undergoing deforestation typical of the early development stages. A country at that stage of development is likely to experience logging, which is frequently carried out in (partial) breach of existing regulations for various reasons; it should be noted, however, that forestry regulations are often complex and do not have a clear scientific basis (Boscolo & Vincent 2000). Illegal logging may be followed by agricultural development, which often occurs in areas formally earmarked as permanent forest estate. Hence, agricultural development is also formally illegal, although generally accepted. Some authors consider illegal logging an underlying cause of deforestation (for example Contreras-Hermosilla 2000), however, the extent of land areas affected by illegal logging and illegal agricultural development is unknown. While several countries are reported to experience illegal logging rates greater than 50% of total harvest (World Bank 2006), these statistics need to be treated with caution. It has been shown, for instance, that the often-cited illegal logging rate of 50% in Cameroon is a significant overestimate of the actual illegal logging rate, and that small-scale logging activities, illegally suspended by the ministry of forestry which did not have the powers to do that, accounted for a significant share of illegal logging (Cerutti & Tacconi 2008). A comparative analysis of the causes of illegal logging shows that it is thought to be driven by the financial benefits it provides, community perceptions that it is not a criminal or harmful activity, conflicting interests over forest management between central and local governments, corruption, and lack of government interest and/or capacity to enforce the law (Tacconi 2007c).

A study that draws on the political economy and public administration literature points out that ignorance, incapacity or incompetence of government officials is not a realistic explanation of bad policies that lead to the misuse of natural resources, including forests, because government officials are often well informed, competent and capable of engaging in very complex policy and political manoeuvres (Ascher 1999). Government agencies may make choices that are not socially optimal because they focus on one or more objectives that are not necessarily related to the conservation of natural resources and their efficient economic use (Ascher 1999). In strong states, institutional interplay among government agencies dominates the decision-making process and reduces the influence of other stakeholders on forest policies (Ascher 1999), such as corporations (for example see Dauvergne 2001). Specifically, the objectives outlined by Ascher (1999) are: (1) financing controversial development programmes

with revenues diverted from natural resource exploitation, because other agencies may otherwise not agree to fund the programmes; (2) providing economic benefits for particular groups, areas or individuals; (3) capturing natural resource rents for the central treasury; (4) creating rent-seeking opportunities to gain private actor cooperation in pursuing other objectives (i.e. political patronage); (5) capturing and maintaining discretion over the financial flows involved in resource exploitation, at the expense of other government or state agencies; and (6) evading accountability through reliance on low visibility resource manoeuvres.

From deforestation to reforestation: economic and governance factors

Several pathways leading to the stabilization and subsequent increase of forest cover have been identified. The first two pathways involve scarcity of goods and services and economic development (Rudel *et al.* 2005). In the scarcity pathway, a decline in the supply of forest products and/or ecological services provided by forests leads first to a reduction in deforestation, then to an increase in forest cover. This reversal in trend may be due to market forces (an increase in the price of timber may lead to replanting of trees to sell them) or to government policies halting deforestation to maintain the supply of environmental services, with these policies possibly being influenced by community's demands. In the economic development pathway, growth generates enough non-farm jobs and non-farm salaries sufficient to outstrip population growth and to attract farmers off marginal agricultural lands. Labour scarcity in rural areas increases agricultural salaries to a level sufficient to drive technological innovation, which concentrates on the most productive lands. These two pathways are consonant with the economic causes of deforestation noted above. The prices of commodities and environmental services (influenced by supply and demand for them), salaries, employment opportunities, income and technology (affected by changes in population, national income and exchange rates among other factors) affect land-use allocation decisions.

Lambin and Meyfroidt (2010) identified three other possible pathways. In the national forest policy pathway, land-use policies are implemented with underlying motivations often outside the forestry sector (although they could also be triggered by forest scarcity), such as a willingness to modernize the economy or promote foreign investments. The globalization pathway is a modern version of the economic development pathway, and it involves national economies becoming increasingly integrated into global markets for commodities, labour, capital, tourism and ideas, as experienced by many developing economies (Lambin & Meyfroidt 2010). The processes that are said to affect forest cover are neoliberal economic reforms, labour migration, local manifestations of international conservation ideas, and tourism and land acquisition by expatriates (Kull *et al.* 2007). The last pathway involves a significant increase in tree cover

resulting from smallholders' expansion of fruit orchards, wood lots, agroforestry systems and secondary successions on abandoned pastures or fallows in marginal regions (Lambin & Meyfroidt 2010). This pathway involves some of the changes described in the scarcity and economic pathways and may be influenced by similar economic variables, but also by other livelihood concerns.

Economic factors are obviously at work in the process of forest transition. They drive deforestation and may lead to a stabilization and reversal in forest cover. Governance factors also play a role. Illegal logging, corruption and policy failures such as those described by Ascher (1999) may lead to greater deforestation than would otherwise take place, may delay the onset of the stabilization phase and limit the extent to which reforestation takes place. In other words, governance factors affect the efficient use of land, economic development opportunities and influence the onset of the forest transition (Barbier *et al.* 2010). To a certain extent, this explanation reconciles the economic and governance causes of deforestation and reforestation. However, this is only a generalized explanation. In practice, still unknown is the extent to which forest ecosystems are managed efficiently from an economic perspective and distortions caused by governance factors are limited, or whether governance variables dominate, thus causing a highly inefficient use of forests. This assessment can only be done at a national level and requires an integrated analysis of the economic and governance variables. Such an integrated analysis is also fundamental to the development of policies aimed at bringing about a reduction in deforestation and, if appropriate, an increase in reforestation. For instance, there is currently significant interest in developing policies to reduce emissions from deforestation and forest degradation (REDD) (see Angelsen 2010). Their design will need to account for the governance factors that influence forest management at the national and subnational level. Corruption, for example, affects forest management as already discussed; it is also expected to impact on the implementation of REDD mechanisms, and the design of anti-corruption measures needs to take into account the conditions of a country's institutions (Tacconi *et al.* 2009).

SOME EXISTING INTERDISCIPLINARY STUDY AREAS

Ecological economics was described as a new transdisciplinary study area addressing the relationships between ecosystems and economic systems (Costanza *et al.* 1991). Transdisciplinarity was used in the sense of integrating and synthesising different disciplinary perspectives, with no discipline having intellectual precedence (Costanza *et al.* 1991). The tools to be used include those of neoclassical economics, ecology, and new intellectual tools and models as appropriate (Costanza *et al.* 1991).

There have been discussions about the need to further expand ecological economics to include considerations of power relationships (Gale 1998) and possible integration

with political ecology (M'Gonigle 1999), a study area further considered below. Ecological economics has drawn not only on neoclassical economics but also on institutional economics (Paavola & Adger 2005). However, the calls noted above to expand the scope of ecological economics and to increase its focus on political and power relationships, as well as calls to other social scientists, such as sociologists and political scientists, to contribute to ecological economics (Söderbaum 2000), have not led to significant changes in how ecological economics is practised and taught. There has been some attention given to the issue of politics, but this has been limited, and focused on reframing the individual agent as a 'political individual' in contrast to the 'economic individual' (Faber *et al.* 2002; Söderbaum 2004), and it has not yet addressed the influence of power and political organizations on the environment (Gale 1998). This point is also demonstrated by the focus on economics and ecology taken by one of the major recent textbooks on ecological economics (namely Common & Stagl 2005), and by the description of the defining characteristics of ecological economics as economics, nature, justice and time (Faber 2008), a definition that does not include power or politics.

Instead power is at the core of political ecology, which focuses on the political dynamics surrounding material and discursive conflicts over the environment (Bryant 1998). Political ecology developed as a reaction to the lack of attention within human ecology and economic anthropology to the political aspects of environmental and resource management (Vayda & Walters 1999) and to the constraints of place-based natural resource management research, that did not account for cross-scale social, political and ecological interactions (Neumann 2005). It studies the human-environment systems with a focus on power in social relationships, institutions, and the influences of class, gender, identity and knowledge (Armitage 2008). Armitage (2008) pointed out that political ecology has been criticized because (1) scholars have provided critiques but few solutions (but it should be noted that recently a debate about a more engaged political ecology has emerged; Neumann 2008) and (2) most political ecology analysis involves little ecology (Vayda & Walters 1999), and could therefore be more accurately termed environmental politics. However, environmental politics is rather different from political ecology, as a result of its disciplinary roots and as currently practised. Environmental politics originates in the political sciences and focuses on the study of: (1) political theories and ideas related to the environment; (2) the examination of political parties and environmental social movements; and (3) public policy and the environment (Carter 2007). Peterson (2000) noted the lack of focus of political ecology work on ecological dynamics, leading him to describe it as the study of the political economy of natural resources, and proposed a resilience approach to political ecology that integrated systems dynamics, scale and cross-scale interactions in both natural and human systems.

Studying the dynamic interactions between ecosystems and society is at the core of sustainability science that has emerged during the past two decades, and it is defined by the problems it addresses rather than the disciplines it employs (Clark 2007). It is aimed at improving the collaboration between natural and social scientists as well as delivering research designs that better integrate all scales from local to global (Kates *et al.* 2001). It revolves around a set of core questions (Bolin *et al.* 2000) such as: (1) How can the dynamic interactions between nature and society be better incorporated in emerging models and conceptualizations that integrate the Earth system, human development, and sustainability? (2) How are long-term trends in environment and development, including consumption and population, reshaping nature-society interactions in ways relevant to sustainability? (3) What systems of incentive structures, including markets, rules, norms and scientific information, can most effectively improve social capacity to guide interactions between nature and society toward more sustainable trajectories?

The term sustainability science may give the impression that it is a mature discipline, which implies a set of shared conceptual and theoretical components that may not yet exist (Clark & Dickson 2003). A better descriptor may be 'the science of sustainability', which implies that multiple sciences are involved in addressing a common theme (Clark & Dickson 2003). This can be described as a multidisciplinary approach to the study of environmental problems. However, the journal *Proceedings of the National Academy of Sciences* now dedicates a section to sustainability science (Clark 2007), and the journal *Sustainability Science* has recently been established, proposing sustainability science as a new discipline (Komiyama & Takeuchi 2006). It is noted that sustainability science should be transdisciplinary, including natural and social sciences (Komiyama & Takeuchi 2006), but it is not specified which sciences might be included and how they will be integrated in a transdisciplinary approach.

Earth system governance is at the interface of earth system analysis and governance theory (Biermann 2007). Earth system analysis builds on quantification and computer-based modelling to integrate models of different strands of research to understand the processes in nature and human behaviour. It is unclear the extent to which governance research can be integrated with these more model-driven studies, but Biermann (2007) saw quantifiable hypotheses and computer-based modelling as unsuited for scholars of institutions and governance, and argued that they should resist subjecting their governance and institutional analysis to computer-modelling. According to Biermann (2007), social scientists should develop independent interdisciplinary research programmes involving different social sciences, such as international relations and law, that have compatible theoretical, epistemological and methodological approaches that are essentially qualitative, case-based, context-dependent and reflexive. Economic and ecological studies, which in some cases can employ quantitative methods and computer modelling, do not seem to be included in Earth system governance.

ENVIRONMENTAL GOVERNANCE

There are many definitions of governance (Kjær 2004), hence there is no widely accepted definition of environmental governance. It is therefore useful to start by considering some definitional issues and the potential scope of environmental governance research. This is followed by a discussion of theoretical aspects, normative and empirical research, and methodological issues.

Definitions and scope

Governance is evidently not synonymous with government (Rhodes 2007), the former including the interactions among the various stakeholders (including government, non-governmental organizations [NGOs] and business) and applying at various scales, such as sub-national and global (Krahman 2003). There appears to be some convergence, at least in the academic literature, towards governance being 'about the rules of collective decision-making in settings where there are a plurality of actors or organizations and where no formal control system can dictate the terms of the relationship between these actors and organizations (Chhotray & Stoker, 2010 p. 3). Environmental governance is also described as 'the set of regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes. Governance is not the same as government. It includes the actions of the state and, in addition, encompasses actors such as communities, businesses, and NGOs' (Lemos & Agrawal 2006, p. 298). Drawing on Chhotray and Stoker (2010), Krahman (2003), Lemos and Agrawal (2006) and Hendricks *et al.* (2009), environmental governance as a subject of study can be defined therefore as the formal and informal institutions, rules, mechanisms and processes of collective decision-making that enable stakeholders to influence and coordinate their interdependent needs and interests and their interactions with the environment at the relevant scales.

In relation to the scope of environmental governance studies, Adger and Jordan (2009*b*) identified three strands: (1) the empirical, (2) the theoretical, and (3) the normative. In the empirical strand, scholars have been describing the changing landscape of policy making and implementation in which actors other than government have been assuming a more important role. The theoretical strand has sought to explain the empirical changes described in that strand, and it has focused on markets, networks and hierarchies, the three main governing modes. This strand has not developed a theory of environmental governance that encompasses all aspects being considered, and there is scepticism about such a possibility. The normative strand has concerned itself with identification of good governance policies, for instance, to improve the machinery of government (at the national level), and to address global environmental problems. Some possible future work in environmental governance, with some examples related to forest-related research, is considered below through the prism of this framework, and is followed by some methodological considerations.

Environmental governance theory

An environmental governance theory might never come into existence as a comprehensive grand theory (Young 2005; see also Adger & Jordan 2009*b*). The difficulty, if not the impossibility, of developing an integrated theory is demonstrated by the fact that established academic disciplines often do not have integrated theories at the disciplinary level, such as economics for example, which has integrated theories at the sub-disciplinary level, including in macroeconomics, financial economics and microeconomics. Chhotray and Stocker (2010, p. 11) noted that 'there is an element of chaos in disciplines . . . in which debates between contending schools often reflect the recycling of core ideas and follow a similar pattern across a range of disciplines.' This does not exclude, however, that further theoretical development within specific areas of environmental governance research is impossible, for instance, concerning: (1) global environmental governance processes and how they influence national level decision-making (for example climate change regime and national level forest management); (2) how corruption affects natural resource management and other governance processes (for example decentralized management of forest resources); and (3) the more established area of common property theory (Agrawal 2007). Further theoretical development is indeed useful to explain specific environmental problems, given that explanation is supported by theories. (It should be noted that asserting that explanation is 'supported' by theories, does not imply advocating a positivist view that explanation can only be based on theory and hypothesis testing.) Theory is also useful in the development of policy options to address environmental problems, that is, normative studies.

Normative research on good environmental governance

The idea of good governance has been promoted by international organizations such as the World Bank (Kaufmann *et al.* 2009) and it has also made its way into the environmental literature. The principles of good governance (on which policy reforms are advocated) are based on the traditional view of effective public administration that goes back to the writings of Max Weber on bureaucracy (Chhotray & Stoker 2010). The principles have been criticized because they represent a wish list, and the development studies literature has been debating whether it is at all possible to strengthen governance, particularly with donor-funded programmes based on conditionality (Chhotray & Stoker 2010). Furthermore, political scientists working on environmental issues have noted that there may not be a general recipe for good governance, as it depends on specific problems and world views (Clapp & Dauvergne 2005). There is a need to consider, however, whether the development of principles of good environmental governance could help governments that intend to reform environmental governance, rather than being forced by donors, and whether it is possible to move beyond the relativist view put forward by Clapp

and Dauvergne (2005). The work that may be required to address the latter point is considered later in the section on methodology.

Lockwood *et al.* (2010) noted that to deliver good governance, organizations and the multi-level arrangements within which they work need the guidance of value-based standards. Lockwood *et al.* (2010) also stressed that principles are important because they are normative statements about how governance actors should exercise their powers in meeting their objectives. It could be argued that there is already starting to be a proliferation of good environmental governance principles with general ones (United Nations Development Programme *et al.* 2003), for natural resource management (Lockwood *et al.* 2010), for the management of oceans (Costanza *et al.* 1999), and for forests (Brito *et al.* 2009). These principles need to be compared and refined, and to the extent possible based on existing theory. However, given the absence of general theory of environmental governance, it is difficult to state exactly which principles are the most significant from a functional perspective (Table 1). Those developed by Lockwood *et al.* (2010) draw on those advanced by Costanza *et al.* (1999) but the two sets differ. The former are more focused on public policy issues, sociological aspects and equity, and miss the efficiency aspect (Table 1). The latter are more focused on science and efficiency, although they include the issue of participation. Neither set considers explicitly the issue of corruption, which is included, for example, in the governance indicators of the World Bank (Kaufmann *et al.* 2009). Issues to be considered by future work include: (1) whether sufficiently simple and general environmental governance indicators can be developed, or whether sectoral ones (for example, forestry) are to be preferred; (2) the scale at which the principles (and related indicators) can be targeted (for instance, local, regional or national); (3) whether they can be measured objectively and compared across geographical units (for example, regions or countries) and time; and (4) whether indicators need to take into account the development stage of a specific country and its institutions, as pointed out in relation to the prioritization of governance policies by Grindle (2007).

Another important area of normative research is the development of policies aimed at improving the management of specific ecosystems and resources. As an example, it was noted above that currently there is significant interest in policies that could reduce deforestation. Environmental governance research integrating economic, social and political viewpoints, could provide a much needed input to the development of efficient, equitable and politically viable policies.

Empirical research on environmental governance

Three significant areas for empirical research include hypothesis testing, assessment of policy uptake and its impacts, and new exploratory research.

Firstly, the theoretical work discussed earlier will require testing of hypotheses. For example, further studies of the theoretical relationships between corruption and resource management (for example see Kolstad & Søreide 2009) will need to consider other factors such as decentralization. These relationships will have to be tested empirically, which may involve quantitative and qualitative methods.

Secondly, the normative work discussed above on policy development leads to specific recommendations for policy reform. Whether those recommendations are taken up and why will have to be assessed empirically. If they are adopted, their impacts will have to be assessed, and eventually the recommendations revised. For example, improvements in transparency are often recommended for better natural resources management. However, what should be made more transparent needs to be understood as well as the impacts, because in some cases improved transparency could have negative effects (see Kolstad & Wiig 2009).

Thirdly, there will always be a need for inductive, exploratory empirical work aimed at discovering new issues and patterns (for example Auld *et al.* 2009) in order to inform the improvement of existing theories, and the development of new ones.

Methodological issues

The review of deforestation and reforestation processes demonstrates the need for interdisciplinary research integrating economic, governance, social and environmental aspects. The need for 'multidisciplinary' research to understand changes in governance has already been noted (van Kersbergen & van Waarden 2004). However, there are at least two aspects that have to be addressed. The first is the type of disciplinary integration that could take place, and the second relates to the methodology to be used.

Interdisciplinarity and transdisciplinarity can be considered as a continuum on the road to integration, and a staged approach can be envisaged, starting with interdisciplinary research and ending with transdisciplinarity, if the ontologies, epistemologies and methodologies of the relevant disciplines, sub-disciplines and/or study areas can be successfully integrated. There are several obstacles to interdisciplinary work and to achieving transdisciplinarity. Bauer (1990) noted that disciplines cannot be separated from their practitioners, and only in pseudoscience an individual or group can quickly synthesize several disciplines. An interdisciplinary approach would therefore be the first step to start developing shared language and understanding among the different practitioners. Even then, there are barriers to be overcome that include: (1) lack of incentives, education titles, stress level and technological skills (individual barriers); and (2) crossdisciplinary literacy, terminology and stereotyping of other disciplines (group barriers) (Jakobsen *et al.* 2004).

The increased attention to be given to governance factors would obviously benefit from the involvement of political scientists in environmental governance research. A potential specific constraint could be that political scientists do not appear very interested in studying issues such as biodiversity conservation, possibly because they are more interested in

Table 1 Examples of environmental governance principles for ocean sustainability (Costanza *et al.* 1999) and natural resource management (NRM) (Lockwood *et al.* 2010)

Lisbon principles for sustainable ocean governance		*Principles for NRM governance*	
Responsibility principle	Access to environmental resources carries attendant responsibilities to use them in an ecologically sustainable, economically efficient, and socially fair manner	Legitimacy	Refers to (1) the validity of an organization's authority to govern that may be (*a*) conferred by democratic statute or (*b*) earned through the acceptance by stakeholders of an organization's authority to govern; (2) power has been devolved to the lowest level at which it can be effectively exercised; and (3) the integrity with which this authority is exercised
Scale-matching principle	Ecological problems are rarely confined to a single scale. Decision-making on environmental resources should: (1) be assigned to an institutional level or levels that will maximize information about the relevant ecological system and recognize that ecological information needs to flow between them; (2) take ownership and actors into account; and (3) internalize costs and benefits	Integration	Integration refers to (1) the connection between, and coordination across, different governance levels; (2) the connection between, and coordination across, organizations at the same level of governance; and (3) the alignment of priorities, plans and activities across governance organizations
Precautionary principle	In the face of uncertainty about potentially irreversible environmental impacts, decisions concerning the use of environmental resources should err on the side of caution	Accountability	Refers to (1) the allocation and acceptance of responsibility for decisions and actions and (2) the demonstration of whether and how these responsibilities have been met
		Transparency	Refers to (1) the visibility of decision-making processes; (2) the clarity with which the reasoning behind decisions is communicated; and (3) the ready availability of relevant information about governance and performance in an organization
Full cost allocation principle benefits (social and ecological) of alternative	All of the internal and external costs and Fairness decisions concerning the use of environmental resources should be identified and allocated. When appropriate, markets should be adjusted to reflect full costs	Fairness	Refers to (1) the respect and attention given to stakeholders' views; (2) consistency and absence of personal bias in decision making; and (3) the consideration given to distribution of costs and benefits of decisions
Participation principle	All stakeholders should be engaged in the formulation and implementation of decisions concerning environmental resources	Inclusiveness	Inclusiveness refers to opportunities available for stakeholders to participate in and influence decision-making processes and actions
		Capability	Capability refers to the systems, plans, resources, skills, leadership, knowledge and experiences that enable organizations, and the individuals who direct, manage and work for them, to effectively deliver on their responsibilities
Adaptive management principle	Given that some level of uncertainty always exists in environmental resource management, decision-makers should continuously gather and integrate appropriate ecological, social, and economic information with the goal of adaptive improvement	Adaptability	Adaptability refers to (1) the incorporation of new knowledge and learning into decision-making and implementation; (2) anticipation and management of threats, opportunities and associated risks; and (3) systematic reflection on individual, organizational and system performance

studying national level processes rather than local ones, which are the focus of biodiversity conservation studies (Agrawal & Ostrom 2006). Lack of interest in environmental issues among political scientists could also be due to the perception that engaging in interdisciplinary research is beyond the discipline's methods. Political science methods are rooted in positivism, which dominates American political science, which in turn accounts for some 75% of the living political scientists (Marsh & Savigny 2004). Political ecologists are far more interested in interdisciplinary work and in post–positivist methodologies (Forsyth 2003) than mainstream political scientists. This issue points to the fact that there may actually be many political scientists interested in environmental issues (for example Cashore *et al.* 2004) and their input should be sought in the development of a more integrated study area.

With regard to the issue of incentives, there are significant career benefits from participating in disciplinary activities, such as publication in highly rated mainstream journals and peer recognition (Campbell 2005; Moran 2006). Participation in the development of a new, more integrated study area such as environmental governance may not be seen as a priority by those working in disciplinary areas, such as mainstream political scientists. However, there are now many leading journals which regularly publish interdisciplinary environmental research, such as *Ecological Economics*, *Environmental Conservation*, *Global Environmental Change*, and a 'window' for sustainability science in the *Proceedings of the National Academy of Sciences USA*.

Achieving a truly transdisciplinary environmental governance would however take time, as it would require work on the integration of ontologies, epistemologies and methodologies that involves both the preparation of manuscripts discussing how that can be done as well as, and more importantly, a number of researchers 'subscribing' to the new paradigm. To maintain it as a study area, and eventually develop as a discipline, it would also require training of new scientists, which has its own challenges (see Golde & Gallagher 1999).

This development work can draw on existing experience within other environmental study areas (for example Funtowicz & Ravetz 1993; Tacconi 1998; Boulton *et al.* 2005), and bring together quantitative and qualitative methods (Johnson *et al.* 2007). Environmental problems are complex and studying them in an appropriate way requires using the tools most suited to the task, rather than analysing the problem only through the lens of a specific method most familiar to the researcher. A mixed methods research approach is useful for corroborating the findings derived through different methods used to study one phenomenon, using the results from one method to help inform the other method, and discovering paradoxes and contradictions that lead to a reframing of the research question (Johnson *et al.* 2007).

In relation to the methodological issues involved in carrying out the theoretical work discussed earlier, including addressing relativist views of (environmental) governance, due to space constraints we can only consider some general work

required. A world view comprises a set of beliefs, which can be described as the axioms of a theory. While recognizing that the criteria are not objective in the traditional sense of the word, because different scientists may reach different conclusions, theories can be compared, and eventually chosen, on the basis of the following logical criteria (Kuhn 1970):

(1) accuracy: empirically adequate with experimentation and observation;
(2) consistency: internally consistent, and also externally consistent with other theories;
(3) broad scope: the theory's consequences should extend beyond that which it was initially designed to explain;
(4) simplicity: the simplest explanation; and
(5) fruitfulness: disclosing new phenomena or new relationships among phenomena.

Theoretical work in environmental governance, including work on the theories of deforestation and reforestation, could consider the existing (alternative) theories and seek to select among them on the basis of the foregoing principles.

CONCLUSIONS

Significant progress has been made in explaining the causes of deforestation and reforestation, however, uncertainty remains about the relative contributions of governance versus economic causes. The inclusion of governance factors in the analysis and development of policies aimed at reducing deforestation and promoting a transition to reforestation are fundamental to the success of those policies.

The example of forest cover change studies demonstrates the need to integrate economic, political, social and environmental factors in the analysis of environmental problems. Consideration should be given to the development of environmental governance as a new study area. This development has already begun through various research endeavours and teaching programmes. Methodologically, environmental governance might need to start from an interdisciplinary approach, followed by consideration of ways to further integrate the disciplines in a transdisciplinary study area. Environmental governance could use quantitative and qualitative research methods in a mixed methods research approach, and employ the tools of economics, politics, ecology, anthropology, international relations, and other social science disciplines and study areas as appropriate. The focus would be on contributing to the sustainable management of ecosystems.

The review of other interdisciplinary study areas shows that there are similarities between them, and between them and what is proposed here. The fundamental point is that a broader interdisciplinary approach to the study of environmental problems is needed. This approach could originate from an integration of those study areas and environmental governance could be built on that basis. The further fragmentation of environmental studies may be a constraint to the development of a new study area such as environmental governance. This is a real risk given that several interdisciplinary environmental

study areas already exist. This aspect indicates that it is of paramount importance to open a dialogue and develop synergies among interdisciplinary study areas such ecological economics, sustainability science, political ecology and Earth system governance.

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