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Multi-Level Environmental Governance: Exploring the economic explanations

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ABSTRACT
Multi-level environmental governance (MLEG) has become commonplace, yet few attempts have been made to explain in economic terms why it should have emerged. This article examines four economic explanations for MLEG. The first considers it as a solution for overcoming collective action challenges when a large number of actors are involved. The second explanation is that multiple levels of environmental governance may be needed to minimize governance costs. Thirdly, path dependence could explain MLEG. Fourthly, complex and multifunctional resource systems may generate ecosystem service flows that have benefit catchments of different size, and multi-level governance solutions may be needed to link providers and beneficiaries. While they are to a degree complementary, the analysis suggests that the multifunctionality explanation is the most nuanced one of them and offers the best diagnostic for governance challenges that an environmental resource system poses. © 2015 The Authors. *Environmental Policy and Governance* published by ERP Environment and John Wiley & Sons Ltd

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Introduction

MULTI-LEVEL ENVIRONMENTAL GOVERNANCE (MLEG) HAS BECOME COMMONPLACE AS RESULT OF THE PROLIFERATION of the European Union's (EU's) environmental directives (Jordan, 1999) and multi-lateral environmental agreements (Mitchell, 2003). It has been a common subject of research in political science and international relations (e.g. Jordan, 1999; Vogler, 2003; Biermann and Dingwerth, 2004; Najam *et al.*, 2004) but among economists interest in environmental governance was previously limited to scholars of law & economics, economics & politics, and public finance (Costanza *et al.*, 1999; Esty, 1999; Hanna, 1999; Birner and Wittmer, 2004; Paavola, 2007). More recently, the emergence of payments for ecosystem services schemes, carbon markets and other novel institutional solutions has made MLEG an issue of interest to ecological economists as well (e.g. Farley and Costanza, 2010; Vatn, 2010; Paavola, 2011; Rosendal and Andresen, 2011; Ananda and Proctor, 2013; Vatn and Vedeld, 2013). Yet to date, the economic reasons for the emergence of MLEG and their implications remain largely unexplored.

This article examines four economic explanations for the emergence of MLEG and distils what additional insights they could provide for scholars and practitioners interested in the phenomenon. The multi-level environmental governance is increasingly acknowledged as important for ecological economics. For example, Fisher et al. (2008: 2065) 'call for researchers to think about the distribution of ecosystem service provision and use across a

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landscape and its associated human populations so that a variety of benefits capture mechanisms can be considered with due regard to local institutional and cultural contexts'. MLEG solutions are important for example for carbon sequestration and conservation of biodiversity because they can help link local providers of pertinent ecosystem services to beneficiaries spread out across larger spatial scales.

In this article, *environmental governance* is understood as the resolution of conflicts over environmental resources through the establishment, reaffirmation and change of institutional arrangements (see Paavola, 2007). This definition – which will be explained in more depth in the next section – is broader than typical political science definitions (Rhodes, 1996; Stoker, 1998) because it encompasses both state-centred governance solutions and solutions where the state does not play a central role. MLEG in turn encompasses those environmental governance solutions that involve at least two levels of decision-making and action as will be discussed below.

The article examines four potential economic explanations for the emergence of MLEG. First, MLEG could help overcome the challenges of collective action when many actors are involved. Secondly, a multi-level governance structure may minimize governance costs when governance functions have different optimal scales of implementation. Thirdly, path dependence could account for MLEG. Fourthly, multi-functional resource systems can generate many ecosystem service flows with benefit catchments of varying scales: a multi-level structure could be needed to govern their provision and use.

The article first conducts critical conceptual analysis of the above four economic explanations of MLEG. These are then used to account for the emergence of multi-level governance solutions for biodiversity in Europe and the carbon markets based on the Clean Development Mechanism (CDM) established under the United Nations Framework Convention on Climate Change (UNFCCC). The second section will discuss MLEG in more detail. The third section will discuss the four economic explanations of MLEG and the final section concludes and reflects.

Multi-Level Environmental Governance

In this article, environmental governance is understood as the resolution of conflicts over environmental resources through the establishment, reaffirmation or change of institutional arrangements (Paavola and Adger, 2005; Paavola, 2007; for the conflict theory of institutional change see Knight, 1992). As an analytical concept, 'environmental conflict' does not refer to the existence of a strife or open conflict between two or more parties: it refers to situations where different interests in the environment are incompatible and cannot be satisfied simultaneously – a choice has to be made regarding which interests to affirm and which to block, and to what degree is their balancing possible.

An advantage of the conflict-based definition of environmental governance is that it is analytically more encompassing than descriptive definitions emphasizing the absence of government or its limited role as the hallmark of environmental governance. A conflict-based definition of environmental governance also has advantages over definitions based on coordination, which is sometimes suggested as the reason for the existence of institutions (Taylor, 1987). However, the essence of many coordination problems is in fact a conflict. When several ways of conducting matters exist, and one of them has to be chosen, this choice typically entails differential costs and benefits to the actors involved. Under different coordination solutions the beneficiaries and losers are likely to differ. Therefore, conflict arises over which coordination solution and attendant distribution of costs and benefits should be realized. But more importantly, not all conflicts boil down to coordination problems: they are about distributive and procedural justice (Paavola and Adger, 2005). These conflicts are the most important driver of institutional change: they demand institutional responses that settle them one way or another (see Knight, 1992).

Environmental conflicts take place over environmental resources, which include conventional natural resources, such as fisheries and forests, but also biodiversity, the ozone layer and the global atmospheric sinks for greenhouse gases. Environmental resources also encompass environmental safety and the quality of environmental media such as water and air (Paavola, 2007). Many environmental resources are multi-functional in the sense that they generate multiple flows of ecosystem services for multiple beneficiaries located at different scales: this means that different ecosystem services provided by the same resource may have different 'benefit catchments', areas within which the benefits of ecosystem service flows are realized and appropriated (see Balmford *et al.*, 2002; Turner *et al.*, 2003). Environmental conflicts can thus emerge over an individual ecosystem service flow, for example over which of

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the competing irrigators can divert water from a water course to a consumptive water use. But environmental conflicts can also emerge because of claims to different ecosystem service flows. For example, claims to consumptive use of water for irrigation and claims to recreational in-stream uses of water can be in conflict with each other.

The conflict-based definition of environmental governance considers all formal and informal institutions from customary common property arrangements to national environmental policies and multi-lateral environmental agreements as potential instruments for resolving conflicts, without omitting self-governance and other solutions where the state is not a central actor (see Paavola, 2011). Some governance institutions such as customary common property arrangements, local zoning provisions and land use planning processes organize and operationalize pertinent governance functions and processes at a single spatial scale. MLEG is in turn based on institutional solutions that organize and operationalize governance functions and processes at several spatial scales.

Existing literature acknowledges that MLEG solutions can emerge because of either bottom-up or top-down processes. Bottom-up processes are typically based on voluntary collective action and they can give rise to federations or other over-arching institutions to coordinate the functioning of smaller-scale governance solutions (Ostrom, 1998). Ostrom (1990) discusses informal federations of irrigator associations as examples. Comparable but more formal governance solutions have emerged to coordinate local governance efforts for fisheries and shell-fisheries (Berkes, 1992; Hanna, 1998). Blomquist (1992) in turn explored how formal multi-level governance arrangements for groundwater aquifers emerged in California through bottom-up negotiation processes.

Existing literature also demonstrates how many formal multi-level governance solutions have been created by top-down legal processes. The EU's Birds and Habitats directives require both national legislation and local solutions for conservation of biodiversity (Paavola, 2004). The UNFCCC and other multilateral environmental agreements require national actions, programmes or solutions for the planning, coordination and implementation of internationally agreed actions (Paavola, 2005). There is no consensus on why these multilevel structures emerge. Realist international relations scholars consider that nation-states first became environmentally conscious, and then started to act collectively to resolve their shared environmental problems. World systems scholars have argued that political globalization has preceded, and been the driver of, national environmental management (Frank, 1997; Frank *et al.*, 2000). They and constructivists have also suggested that environmental science has fostered international environmental governance by generating shared rationalizations of environmental problems (Meyer *et al.*, 1997).

The questions of how and why MLEG emerges are important, because answers to these questions may be linked to the design and nature of MLEG institutions they give rise to. Top-down processes often generate multi-level institutional structures where smaller jurisdictions are nested within a larger jurisdiction(s). Hooghe and Marks (2003) call these kinds of multi-level governance solutions based on permanent, general-purpose jurisdictions with few levels and non-intersecting membership as 'Type 1'. Examples of Type 1 solutions include the federal state and many environmental policies in federal political systems. Hooghe and Marks (2003) also identify 'Type 2' multi-level governance solutions, which have non-permanent and special-purpose jurisdictions, numerous levels and intersecting memberships. Special districts for the provision of public services are examples (see Blomquist, 1992; Foster, 1997). These kinds of governance solutions are likely to emerge through bottom-up negotiation processes.

The distinction between Type 1 and Type 2 governance solutions proposed by Hooghe and Marks (2003) is linked to the notion of polycentricity proposed by Vincent Ostrom and his colleagues (see Ostrom *et al.*, 1961; Ostrom, 1972) who sought to explain the complex metropolitan governance structures that had emerged in the post-war decades for public service delivery in the United States. These new structures did not have a single core, which had characterized conventional governmental arrangements. Ostrom and his colleagues sought to establish the rationale of this kind of polycentric order, which he defined as 'one where many elements are capable of making mutual adjustments for ordering their relationships with one another within a general system of rules where each element acts with independence of other elements' (Ostrom, 1999: 57). The key interest of Ostrom was clearly the horizontal dispersion of authority to govern. It was at the time a novel phenomenon, one which the established notions of government and governance were not well placed to account for. But vertical structuring of governance is also involved in the examples Ostrom *et al.* (1961) and Ostrom (1972) discuss.

In light of the model proposed by Hooghe and Marks (2003), and the arguments of Ostrom and others regarding polycentricity, there is a continuum of horizontal dispersion of authority from monocentric to polycentric solutions, with hybrid solutions lying somewhere in the middle (Fig. 1 and Lemos and Agrawal, 2006). Hybrid forms of

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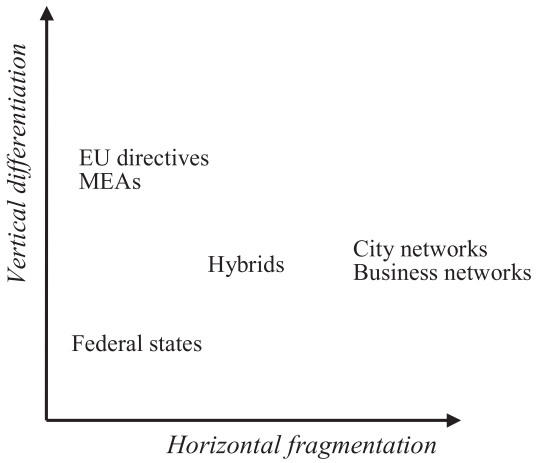

Figure 1. Vertical differentiation and horizontal fragmentation in environmental governance

governance are created by many international environmental conventions: they are explicitly constituted as special purpose jurisdictions vested with limited decision-making and other powers, and they often rely on national and sub-national general jurisdictions at lower levels of governance.

Multi-level governance solutions also differ in terms of their vertical functional differentiation. At one extreme they are functionally identical at each level, like the Russian nesting Matryoshka dolls. In contrast, at the other extreme there could be complete functional differentiation across levels (Fig. 1). Most real examples of environmental governance solutions do not resemble the extremes – but the degrees of horizontal dispersion of authority and vertical functional differentiation do vary across them.

To conclude, there is a reason to expect that MLEG solutions vary in terms of why and how they come about, to what extent authority is concentrated in them, and to what extent their functions are differentiated across different levels. But whatever the type of multi-level governance solution, it is likely to have an economic and political rationale. Because of these substantive differences, it is also likely that there are different explanations for the existence of different multi-level governance solutions. Multi-level solutions will also have economic and political consequences, as do choices between the types of multi-level solutions. While political and other rationales no doubt play important roles in the emergence of MLEG solutions, in what follows I will explore four economic explanations that could account for the phenomenon and discuss what the implications of those explanations is for institutional choice and design.

Economic Rationales of MLEG

There are several potential economic explanations for the emergence of MLEG solutions. In what follows, I will examine four key explanations based on collective action challenges, governance costs, path dependence and multi-functionality. Further economic and non-economic explanations may exist but the aforementioned four explanations help to explore the potential multiple causation of MLEG and its implications.

Collective Action Challenges

The collective action explanation for the existence of MLEG solutions draws its core insights from the seminal work of Mancur Olson. Olson (1971) argued that collective action to bring about mutually advantageous outcomes is more likely to be unsuccessful in large groups where actors deem their impact on collective action outcomes small, and as a consequence have incentives to free-ride. When many actors assess their situation in this way, collective action

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becomes undermined. Olson also saw that there is a difference in the prospects of collective action depending on what kind of goods it seeks to provide: resourceful actors can, for example, provide public goods for themselves, and at the same time make them available for others albeit not in socially optimal amounts.

The key issue here is the large number of agents involved, which creates disincentives to contribute to collective action. One solution to overcome this collective action problem characteristic of large groups is to mobilize collective action at a smaller scale. Keeping the primary collective action groups small would help to overcome the incentive to ride-free because the impact of each individual actor on collective action outcomes increases. At the same time, the smaller size of primary groups may increase the homogeneity of actors, which may also contribute to successful collective action. Homogeneous customary communities that have established common property arrangements are examples of these kinds of small collective action groups (Ostrom, 1990).

Coordination across primary collective action groups can be achieved by establishing larger-scale solutions where primary collective action groups are represented. The introduction of representation reduces the situation of large numbers to a situation of small numbers, where the primary collective action groups are treated as individuals. That is, an MLEG solution can emerge or be adopted as an instrument to facilitate collective action. Federations of irrigators', fishermen's and pasture owners' associations are examples of these kinds of multi-level solutions that have emerged through bottom-up processes (Ostrom, 1998). But the challenges of collective action can also be addressed through a top-down intervention. For example, in Finland the governance of freshwater fisheries was for a long time based on three tiers of self-governing user organizations, the formation of which was mandated by law: the incorporation statutes vested the user organizations with their legal powers and responsibilities (Paavola, 2002a: 23).

Governance Costs

Another explanation of MLEG starts from the costliness of environmental governance as an undertaking, and from the possibility that different governance solutions can imply different levels of governance costs (Williamson, 1999). The costs of governance consist of transaction costs, such as those of devising and agreeing on rules, monitoring and enforcing compliance with them, and resolving conflicts over them.

A multi-level governance solution may minimize governance costs if and when governance functions have different optimal scales of implementation. A brief detour to governance functions helps to clarify the explanation. There have been several different notions of 'governance functions' in the new institutional literature. For example, when discussing common property arrangements, Schlager and Ostrom (1992) distinguish between 'ownership functions' and 'management functions' (see also McCay, 1996). A more detailed typology of governance functions can be distilled from the lists of common features of successful governance solutions presented by Ostrom (1990: 88–102) and Agrawal (2002; see also Paavola, 2007, and Dietz *et al.*, 2003):

- exclusion of unauthorized users;
- distribution of benefits of resource use by regulating it;
- provisioning of rival and non-rival goods and recovering its costs;
- monitoring of resource users and their compliance with rules;
- enforcement of the rules of resource use;
- resolution of conflicts over resource use;
- collective choice for the modification of governance solutions.

In many customary governance solutions all governance functions are organized at the same spatial level, although the way in which they are organized may vary. For example, sometimes users monitor each other and evoke enforcement functions when they observe violation of rules. This was the case with the governance of water quality under common law in the 19th century United States (see Paavola, 2002b). Another possibility would be to appoint 'officials' for monitoring and enforcement functions as has been done in many common property arrangements for forests in developing countries. But when resources are large, it may be that different governance functions have different economies of scale or different optimal scales of implementation (see Ostrom *et al.*, 1961). For example, collective environmental decisions could be best made at a higher level, while the provisioning of the resource at a lower level may be less costly.

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Governance solutions that organize governance functions at different spatial levels are common. For example, co-management of natural resources such as forests in developing countries is based on the relative advantages of undertaking some governance functions, such as raising funds and making collective decisions, at the national level and others, such as monitoring and provisioning, locally. Decision-making and fund raising at the national level entail lower costs than doing them at the local level, because there are economies of scale in these activities for large numbers of forest parcels. It is also less costly to develop expertise and experience in fundraising and interacting with potential sources of funding centrally than across localities. By contrast, local monitoring of natural resource use and provisioning can entail lower costs than central monitoring and provisioning, because of proximity to relevant resources and co-production of monitoring alongside other activities. Co-management also enables states with limited capacity and resources to distribute costs of monitoring and provisioning more widely.

It is noteworthy that the governance cost explanation for MLEG points to different kinds of solutions than the collective action explanation. In light of the collective action explanation, multi-level governance solutions are nested and identical except for their different scale. The governance cost explanation suggests that the levels of governance can be functionally differentiated and complementary.

Path Dependence

Path dependence offers the third route for explaining the emergence of MLEG. Starting points, contingencies and developmental trajectories can shape the future governance alternatives and their relative merits. A key here is that MLEG solutions can replicate some key features of pre-existing governmental templates. That is, once established, multi-level governmental templates structure and shape later MLEG solutions by influencing their relative costs (see Pierson, 2000).

Path dependence is typically attributed to increasing returns processes, which may increase the relative benefits of an initial choice or action over time because of large set-up or fixed costs, learning effects, coordination effects or adaptive expectations (see Arthur, 1994: 112; Pierson, 2000: 254). Increasing returns processes are unpredictable because random changes in the initial conditions can have a large impact on future outcomes (Pierson, 2000: 253). They also make it difficult and/or costly to change from one developmental path to another, and may result in 'lock-in' to ineffective solutions (ibid.). While path dependence arguments originate from the study of technological change, they have also been applied to institutional change (North, 1990; Pierson, 2000). Pierson (2000) sees that large set-up costs of institutions are a reason for increasing returns in politics.

The above reasoning has often been used to explain why arguably ineffective institutional solutions such as state-centred regulatory governance solutions can persist. However, the economies of scope can help to provide an efficiency-based explanation for path dependency and the dominant role of the state in political matters. States and sub-national political sub-divisions could enjoy economies of scope just like a multi-product firm: the state adoption of new functions could lower the costs of carrying out its already existing functions (Panzar and Willig, 1981; Teece, 1980). Teng (2000) argues that this kind of complementarity exists between the two core governmental functions of taxation and enforcement of private property rights. Further functions such as defence, the provision of law and order, public service delivery, and the provision of public goods could also involve economies of scope.

If states and local governments do enjoy economies of scope, over time they would become the lowest-cost undertakers of the functions that they perform: stand-alone alternatives would have narrower bundles of functions and thus higher costs. A similar argument could be based on the work of Coase (1937) who argued that firms exist because their internal hierarchies entail lower transaction costs in carrying out certain functions than performing the same functions over the market. The volume of transactions influences unit transaction costs because of economies of scale in transacting. However, economies of scope can also prevail in transacting: a portfolio of functions can help to attain a larger volume of transactions than a single function and thus reduce costs.

The discussion above suggests that the establishment of central states and local governments may have increased the relative cost of using other institutional solutions. Path dependence makes states default players in discussions and actions on large-scale environmental issues. From the viewpoint of this explanation, it is ultimately the states that will have to act, either directly or by authorizing other actors such as civil society organizations, businesses or networks to take responsibility and action. Local governments occupy a similar role at a smaller scale, while remaining subsidiaries of the state.

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Multi-level governance solutions can thus emerge to reproduce the way in which sovereignty and the use of mandatory power have been customarily organized. This could be cost-effective if economies of scope are involved. For example, a study by Foster (1997) indicates that special districts for the delivery of public services such as transport or drainage are costlier than public service delivery by general-purpose jurisdictions. Of course, special districts have to offer some advantages to exist at all. Following Ostrom *et al.* (1961), one such advantage may be to achieve a larger scale that includes all affected parties and internalizes externalities that prevail between them. If the resulting higher level of costs *is* efficient, then the cost advantage of smaller general-purpose jurisdictions would be explained by the presence of negative externalities in them.

Multi-functionality

The fourth explanation for MLEG is the multi-functionality of environmental resources. Multi-functionality refers to the possibility of multiple use of natural resources such as forests and watercourses. As a term, multi-functionality was widely used in debates on the reform of the Common Agricultural Policy (CAP) of the EU as an argument for the detachment of agricultural subsidies from agricultural production, and their attachment to the provision of environmental benefits in 'multi-functional' agriculture (e.g. Vatn, 2002). Multi-functionality is best exemplified with the help of the ecosystem service literature.

The ecosystem service approach has to be seen in contrast to the conventional economic treatment of environmental goods and bads. Conventional consumer theory conceptualizes the environment as fundamentally similar to the other goods that we consume: utility is the only relevant attribute of environmental goods, which are fully substitutable by other goods. By contrast, the ecosystem service approach ties well with Lancaster's (1966) view of goods as having a multitude of attributes, which provide consumers with utility separately from each other. Ecosystem services can be defined as 'the benefits humans receive, directly or indirectly, from ecosystems' (Costanza *et al.*, 1997: 253; see also Farber *et al.*, 2006: 118) or as 'the end products of nature that yield human wellbeing' (Boyd and Banzhaf, 2005: 16). Examples of ecosystem services that benefit humans include the recycling of nutrients, regulation of run-off and river discharge, coastal protection and carbon sequestration (De Groot *et al.*, 2002: 396). Ecosystem services are generated by ecosystem functions, such as regulation, habitat, production and information, which in turn are underpinned by ecosystem structures and processes (ibid., 394; see also Paavola, 2008).

Multi-functional resources can generate several benefit flows (e.g. Costanza *et al.*, 1997, 2014) and there is no compelling reason why the 'catchments' of different benefit flows would coincide. For example, tropical forests provide timber, charcoal, fuel wood and various non-timber forest products to local users, hydrological, recreational and landscape amenity benefits for a wider user group, and global carbon sequestration benefits. Other resources such as wetlands, the coastal zone and grasslands also generate benefit flows for beneficiaries at different spatial scales.

The multi-functional view of resource systems also has parallels with discussions on polycentric order and government. Ostrom *et al.* (1961) considered different optimal scales of the provision of public goods and services to be a key driver leading to the emergence of polycentric order. Multi-functional resources similarly provide benefits to spatially specific groups of beneficiaries, which will differ from one ecosystem service to another. Moreover, the continued existence of these services has to be provided for, and the provisioning involves both direct costs and opportunity costs. These costs are again accrued to spatially specific groups. Therefore, just as with the provisioning of public services, the provisioning of a multitude of ecosystem services from multi-functional resources could be most effectively arranged by using many spatially divergent governance solutions.

There are not only efficiency but also equity-related reasons for multi-level governance of multi-functional resources, which relate to conflicts between beneficiaries whose benefit catchments are different in size or whose benefits are linked over time. For example, sustained provision of carbon sequestration and hydrological services by tropical forests in the future requires restraining the harvesting of timber, charcoal and fuel wood now. The opportunity cost of conservation is local and present, and the benefits of conservation are mostly accruing to others than those who will bear its costs and often in the future. As decisions on conservation are in the end often made locally by land users and managers, interests in more widely distributed or future benefits are not acknowledged unless redistribution addresses the inequitable incidence of benefits and costs of ecosystem service provision (Balmford *et al.*, 2002; Turner *et al.*, 2003). This requires decisions on and raising of funds over a larger geographical area, and solutions for channelling funds to cover the opportunity costs of conservation.

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To summarize, when multi-functional resources generate multiple ecosystem services that have different spatial scales, they may require multiple jurisdictions and governance solutions to link them together to ensure equitable sharing of benefits and burdens. Here the underlying rationale of MLEG solutions is maximization of the total value of ecosystem services, and the fair distribution of burdens and benefits of ecosystem service provision as one of its preconditions. Equity is needed for the legitimacy and effectiveness of governance solutions.

Discussion

The above examination of the four economic explanations for the emergence of MLEG solutions was largely conceptual and general. In what follows, I will first examine two empirical examples of MLEG to shed more light on the alternative economic explanations. While two cases cannot obviously represent the whole landscape of MLEG, their analysis does help shed additional light on the economic explanations. After this, I seek to draw out the implications of the arguments developed in the article for MLEG and its analysis more generally.

The emergence of multi-level governance of biodiversity in Europe as a result of the adoption and implementation of the Habitats Directive (HD) (92/43/EEC) helps tease out some additional insights regarding the four explanations discussed above (The Birds Directive is also an constitutive of multi-level governance of biodiversity in Europe, but it is omitted here for space considerations). In Europe, multi-level governance of biodiversity encompasses the EU rules and processes, the transposition of the EU rules into member state legislation and policies, and the local management plans developed for designated protected areas. HD Article 3 requires member states to designate sites for habitat and species conservation in conformance with the guidance provided in the Directive's Annexes I and II (HD, 92/43/EEC). Article 5 empowers the Commission to request amendments from a member state if its list does not adequately reflect its habitat types and priority species and it can have omitted sites included into the list if member states do not include them voluntarily. The member states were to designate the selected sites as Special Areas of Conservation to create a European network of such areas known as Natura 2000 by 2004.

The implementation of the HD has been controversial and it encountered substantial delays. For example, conflicts arose in several member states over the designation of protected areas (see Paavola, 2004; Niedziałkowski *et al*., 2013). The Commission also took many member states such as Denmark, Finland, France, Germany, Greece, Ireland and the Netherlands to the European Court of Justice because they failed to submit lists of designated sites in conformance with the deadlines and other requirements of Article 3 (Commission of European Union, 1998), and because some member states did not take measures identified in Article 6 to prevent degradation of sites.

The emergence of multi-level governance of biodiversity in Europe is not easily explained by the collective action theory. Member states clearly lacked political will to implement the directive, which begs the question whether they would have pursued it collectively. Indeed, Fairbrass and Jordan (2001) suggest that the environmental non-governmental organizations outmanoeuvred national political decision-makers by acting at the new European level of decision-making to advance biodiversity protection against political decision-makers' preferences. It is also unlikely that governance cost considerations would have favoured the relatively complex multi-level governance solution for biodiversity in Europe.

A combination of multi-functionality and path dependence explanations appears more plausible. Biodiversity is endangered by land use and conversely its conservation demands land use change, scaling down or giving up land uses that threaten the conservation of biodiversity. The benefits of developmental activities threatening biodiversity are typically spatially more confined and captured at the local or national scales. In contrast, the more diffuse benefits associated with the conservation of biodiversity are enjoyed on wider regional if not global scale. Ensuring the provision of biodiversity-related benefits thus demands response at a supranational level. A multi-level structure emerged partly because of path dependence: the EU cannot directly legislate on national matters, it has to achieve its goals through the transposition of EU rules into national legislation (Jordan, 1999). Multi-functionality suggests that local level of governance is also needed: local knowledge is needed on land uses and the resource system to ensure the set of activities taking place will help achieve the conservation of biodiversity.

Multi-level governance of carbon markets offers another example to reflect on the relative merits and implications of different economic explanations of environmental governance. The Clean Development Mechanism

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(CDM) established carbon markets so that Annex 1 countries can make extra-territorial greenhouse gas emission reductions in a cost-effective way. Project developers working on, for example, energy efficiency, renewable energy or afforestation projects in developing countries can have the emission reductions of their projects certified under the processes established by the CDM to obtain Certified Emission Reductions, and then trade them on carbon markets (see Wood *et al.*, 2015). But the CDM not only seeks to generate cost-effective global mitigation benefits. Kyoto Protocol's Article 12, Paragraph 2, designates as its other objective 'to assist parties not included in Annex I in achieving sustainable development'. As a result, CDM governance involves a national level for which the primary concern is the sustainable development contribution of CDM activity, and an international level for which the primary concern is the verifiability, additionality and permanence of emission reductions.

Why should this multi-level governance structure have emerged? From the viewpoint of the collective action explanation, having a global framework for trading Certified Emission Reductions can be advantageous, and the existence of the national level of governance is necessary for benefit sharing suggested by the goals of the CDM. The governance cost explanation complements this by suggesting that verifiability, additionality and permanence may be most cost-effective when organized at the international level, whereas the sustainable development contribution may be ascertained at a lower cost at the national level. The path dependence explanation sees the two-level structure just as the replication of typical governance arrangement structures created by multilateral environmental agreements after their ratification.

While it is likely that collective action in pursuit of benefits from trade in carbon reductions is behind the establishment of multi-level governance solutions for carbon markets, the multi-functionality explanation helps shed critical light on the existing governance structures. While all CDM projects are supposed to generate global greenhouse gas mitigation benefits, the costs of providing those benefits can be distributed quite differently across types of projects. In many instances, the host communities of CDM projects bear a proportion of the costs, and only have a weak and uncertain claim to sustainable development benefits (Boyd *et al.*, 2009; Mathur *et al.*, 2014). Therefore, the national level of governance may not be sufficient to ensure the sustainable development contribution of CDM projects: local/lower level involvement might be needed (Mathur *et al.*, 2014). In Peru, national governance arrangements provide for the inclusion of local considerations into the assessment of sustainable development contribution of CDM projects (Boyd *et al.*, 2009).

The four explanations for the emergence of MLEG explored above are complementary in the sense that they all offer insights into the rationale, functioning and solutions for MLEG. The collective action explanation best accounts for the bottom-up emergence of voluntary or contractual multi-level governance solutions for the pursuit of collective gain among involved actors. It also resonates with cost–benefit theories of institutional change, which consider that institutions change when the benefits of doing so compensate for its costs (Paavola and Adger, 2005). However, it is weaker in explaining the rationale of top-down multi-level governance solutions, which do not always offer obvious benefits for all actors.

The multi-functionality explanation provides the most nuanced explanation for why multi-level governance solutions are needed: to organize transfers between beneficiaries and providers of ecosystem services flows that are appropriated at different spatial scales. Sometimes this can take place against the interests of some actors to maximize the joint volume of different ecosystem service flows (Turner *et al.*, 2003). Clearly in some situations such as in carbon markets the governance solutions remain incomplete, and cannot perform all the functions that multi-functionality would entail. This means that they may not deliver the outcomes expected of them. The weaknesses in the governance of carbon markets may, for example, mean that purported carbon reductions are not additional or permanent, or that leakage occurs when adversely affected members of host communities replace curtailed resource use options by next best alternatives (Rendón Thompson *et al.*, 2013).

The governance cost and path dependence explanations are somewhat subsidiary to the collective action and multi-functionality explanations: one or the other of the latter needs to provide the overall rationale for governance initiative, and governance cost and path dependence explanations can then rationalize why the initiative needs to have a multi-level character. Both highlight that conventional governmental structures may need to be relied upon, and that doing so may be the most cost-effective solution. However, there are also situations where expertise or its lack, importance of local knowledge, ease of access or transaction costs call for additional institutional features such as local involvement in co-management.

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The existence of multiple reasons for MLEG highlights that there are no one-size-fits-all panacea in environmental governance (Ostrom *et al*., 2007), and that governance solutions have to match the governance problem at hand. The multi-functionality approach provides the best diagnostic for environmental governance challenges. The other explanations complement the multi-functionality explanation by highlighting what institutional features might most feasibly be brought about. A limitation of all the discussed explanations is that they do not shed much light on the power of certain groups of actors to influence decisions on multi-level governance arrangements, although this is clearly an important issue for example in the case of biodiversity governance in Europe and the governance of global carbon markets.

Conclusions

MLEG has become part of the political reality in recent decades, and ecological economists are increasingly interested in it. This article has demonstrated that the theories of collective action, governance costs, path dependence and multi-functionality all offer somewhat distinct economic explanations of the emergence of MLEG solutions. While they are to a degree complementary, the multi-functionality explanation is the most nuanced and offers the best diagnostic for governance challenges that an environmental resource system poses.

Perhaps more importantly, the institutional design of MLEG solutions must be theoretically informed and the above analysis suggests that different theories provide different insights. Collective action theory as it is commonly deployed does not draw sufficient attention to environmental governance challenges and therefore can lead to institutional solutions such as current governance of carbon markets under CDM that do not fully address the governance challenges. The multi-functionality approach would help to avoid this. Path dependence theories would in turn call for careful analysis of reasons for or problems of structuring governance initiatives in specific ways. Examples include transition to catchment-based management of water resources under the Water Framework Directive in Europe or de-politicization of areas of environmental governance by delegating authority for them to entities outside of public administration.

While ecological economists have not yet fully embraced the study of environmental governance solutions, it clearly has potential for exciting further research. The contemporary complex governance arrangements constitute a fertile research object, calling for us to understand their economic rationale, functioning and implications. Ecological economists can build on the seminal contributions of scholars such as Vincent Ostrom, Charles Tiebout and Elinor Ostrom, but there is clearly ample space for further contributions.

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