



## Original Article

# Ecosystem Services and Environmental Governance: Comparing China and the U.S.

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### Abstract

*The concept of ecosystem services (the benefits people derive from functioning ecosystems) is beginning to change the way we view the relationship between humans and the rest of nature. To the extent that we view humanity as embedded in and interdependent with the rest of nature, rather than viewing nature as separate from people or even as an adversary, our whole approach to environmental research, governance and management changes. These ongoing changes are discussed with reference to the evolving situations in China and the United States. The most significant effects on governance are the needs to shift to a more transparent and participatory approach and a broader recognition of the public goods/common property characteristics of ecosystems and their services. The main questions are: (i) to what extent do prevailing governance arrangements in China and the United States facilitate and/or hinder efforts to effectively manage ecosystem services?; and (ii) are there*

*adjustments that are both politically feasible and likely to make a difference in these terms? We conclude that while China and the United States represent two almost polar opposite starting points, especially as concerns property rights, there is significant convergence, and the concept of ecosystem services can help accelerate this positive trend.*

**Key words:** ecosystem services, governance, China

### 1. Background

Ecosystem services are defined as ‘the benefits people obtain from ecosystems’ (Costanza & Folke 1997; Costanza et al. 1997; Millennium Ecosystem Assessment 2005). These include provisioning services such as food, water and medicinal plants; regulating services such as air quality regulation, water purification, regulation of flood, drought and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, scientific and spiritual benefits (Costanza & Folke 1997; Costanza et al. 1997; Daily 1997; de Groot et al. 2002).

Ecosystem services are becoming increasingly threatened globally (Millennium Ecosystem Assessment 2005). This trend is partially due to a lack of appreciation of their value, because resources that are not valued are often ignored in decision-making (Costanza & Folke 1997; Costanza et al. 1997; Sukhdev 2008). Referring to environmental assets as ‘priceless’ and ‘invaluable’ has

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proven woefully insufficient in terms of reducing or halting ecosystem degradation. The challenge then is to acknowledge the multiple contributions of ecosystem services to human well-being while managing them as public goods (Costanza 2008; Ehrlich & Pringle 2008).

Ecosystem services valuation (ESV) is the process of assessing the contributions of ecosystem services to sustainable human well-being, including sustainable scale, fair distribution and efficient allocation (Costanza & Folke 1997; Liu et al. 2010). Valuation of ecosystem services has become one of the fastest growing areas of environmental research (Turner et al. 2003; Costanza & Kubiszewski 2012). More recently, efforts such as the Millennium Ecosystem Assessment (2003, 2005) and The Economics of Ecosystems and Biodiversity (Sukhdev 2008), increasingly recognise the critical role of ecosystem service valuation for sustainable development.

## 2. Ecosystem Services Research in China

In China, ESV has also become one of the most significant and fastest growing areas of research in recent decades (Zhang et al. 2010; Chen et al. 2014). However, most research results are inaccessible to the global research community because they are not reported in English. The limited number of works published in English (e.g. Guo et al. 2000; Xu et al. 2003; Xiao et al. 2005; Jim & Chen 2006; Wang et al. 2009; Chen et al. 2014) are valuable, but they do not tell the whole story of ESV research in China. ESV research in China could benefit from increased collaboration. Such collaboration is mutually beneficial for several reasons. First, some of China's environmental problems are of global significance and require solutions beyond the country's borders. With the world's fourth largest territory, the largest population and the fastest growing economy, China generates significant global environmental impacts (MacBean 2007). Likewise, the rest of the world affect China's environment through trade, investment and resource exploitation (Liu & Diamond 2005). Invasive plant species, for

instance, are predicted to increase in China due to their rapidly growing international trade (Weber & Li 2008). On the other hand, China has been recognised as a potential source for new invasive species in the United States (United States National Research Council 2002), and the three best-known pests of North American tree populations all originated in China or somewhere nearby in East Asia (Xie et al. 2001). The control of invasive species is an international, sometimes global enterprise that always involves the collaboration of multiple countries (Perrings et al. 2002). Second, political and cultural differences between China and other countries pose new challenges to and opportunities for ESV research. For instance, concentration of political power enables China to secure the resources to conduct some extremely ambitious projects. China has or is currently carrying out the three largest development projects in the world: The Three Gorges Dam, the South-to-North Water Diversion Project and the development of Western China. All of these are expected to cause huge environmental problems (Liu & Diamond 2005). At the same time, China has the two largest payment for ecosystem services projects in the world in terms of scale, payment and duration (Liu et al. 2008): the National Forest Conservation Program and the Grain to Green Program. These long-term and large-scale projects offer ESV scholars unique opportunities to assess the value of ecosystem services (e.g. Chen et al. 2009) and a heightened necessity to do so.

Zhang et al. (2010) review the history of ESV research in China and point out the effects of ESV studies in creating public environmental awareness and in providing a scientific basis for eco-compensation mechanisms (i.e. payments for ecosystem services). This brings us to one of the major differences in the governance regimes in China and the United States—property rights regimes. Most countries are a mix of private and state ownership, but the United States and China represent the current extremes. The United States is dominated by private property regimes and laws (even though there are significant areas of public lands, especially in the west), while

**Table 1 Eco-services Classified According to Rivalness and Excludability (Costanza 2008)**

	<i>Excludable</i>	<i>Non-excludable</i>
Rival	Market goods and services (some provisioning services)	Common pool resources (some provisioning services)
Non-rival	Congestible services (some provisioning services)	Public goods and services (most regulatory and cultural services)

China is dominated by state ownership (even though private property is now significant). Next, we focus on the implications of this for ecosystem services and environmental governance.

### 3. Property Rights, Ecosystem Services and Environmental Governance

One way to classify ecosystem services is according to their 'excludability and rivalness' status. Table 1 arrays these two characteristics against each other in a matrix which leads to four categories of goods and services. Goods and services are 'excludable' to the degree that individuals can be excluded from benefiting from them. Mostly privately owned, marketed goods and services are relatively easily excludable. I can prevent others from eating the tomatoes I have grown, or the timber I have harvested or the fish I have caught unless they pay me. But it is difficult or impossible to exclude others from benefiting from many public goods, like a well-regulated climate, fish in the open ocean or the aesthetic benefits of a forest. Goods and services are 'rival' to the degree that one person's benefiting from them interferes with or is rival with other's benefiting from them. If I eat the tomato or the fish, you cannot also eat it. But if I benefit from a well-regulated climate, you can also do the same. Excludability is largely a function of supply (to what extent can producers exclude users) and is related to the cultural and institutional mechanisms available to enforce exclusion, while rivalness is a function of demand (how do benefits depend on other users) and is more a characteristic of the good or service itself. Table 1 places ecosystem services into the four categories that this two-by-two matrix creates.

Private property and conventional markets work reasonably well for the allocation of goods and services that are both rival and excludable (the upper left box in Table 1). But they do not work well for allocating goods and services that fall in the other three categories. Most ecosystem services fall into these other categories and are therefore usually not privatised or marketed.

In the United States, private property has been the rule, and the recent tendency has been to attempt to use market mechanisms to pay private landowners for ecosystem services production (Farley & Costanza 2010). In China, common property has been the rule since 1949, and the recent tendency has been to allow more private ownership and control over land use and to financially compensate individuals for lost opportunities (Zhang et al. 2010, similar to the idea of payment for ecosystem services used in many other countries (Farley & Costanza 2010).

Ruhl et al. (2007) document the 'anti-ecosystem services bias' prevalent in American property law, regulation and social norms, and detail statutes and regulations for resource protection of individual US states. One particularly interesting counter-trend to this bias emerges in the 'public trust doctrine', an idea that law professor Joseph Sax identified in the 1970s as the only legal doctrine with the breadth and substance to be useful as a comprehensive approach to natural resource (and ecosystem service) management. While the public trust doctrine may one day fulfil this role, so far the US Supreme Court has declined to use it for that purpose. Recent proposals to expand the 'commons sector' of the United States and the global economy by creating 'common asset trusts' to manage the atmosphere, water and other natural capital assets

(structured like the Alaska Permanent Fund or the many existing land trusts) may be one way of implementing this doctrine (Barnes 2006; Barnes et al. 2008). For example, a bill was introduced in the Vermont Senate in 2007 and reintroduced in 2011 to create a 'Vermont Common Asset Trust', based on the public trust doctrine, to 'propertise' (but not privatise) the state's natural and social capital assets in order to better manage them on behalf of their common stakeholders (both living and future).

The basic idea behind common property rights is that resources created by nature or society as a whole should belong to society as a whole, including future generations. The misleadingly labelled 'tragedy of the commons' results from no ownership or open access to resources, not common ownership. Open access to natural capital is well known to lead to its overuse. However, abundant research shows that resources owned in common can be effectively managed through collective institutions that assure cooperative compliance with established rules (Ostrom 1990). When a resource is rival but non-excludable, it can be 'propertised' (which is to say, made excludable) to prevent overuse. Governments—or in the case of global resources such as atmospheric waste absorption capacity or oceanic fisheries, a coalition of global governments—are generally required to create and enforce property rights. The public sector must cap resource use at rates less than or equal to renewal rates, which is compatible with inalienable property rights for future generations. Since the resources under discussion were created by nature and enforcement of property rights requires the cooperative efforts of society as a whole, rights to the resource should also belong to society as a whole. Individuals who wish to use the resource for private gain must compensate society for the right to do so. The basic idea is a cap and auction scheme in which the revenue is shared equally among all members of society, or else invested for the common good (Barnes et al. 2008). Preventing the resale of the temporary use-rights would reduce the potential for speculation and private capture of rent. Under common ownership, both costs and benefits

accrue to society as a whole, and the two are likely to be brought into balance. Taxes on waste emissions and resource extraction can serve the same purpose as a cap and auction system.

When a resource is non-rival, excludable property rights are inappropriate, but lack of property rights eliminates private sector incentives to provide or protect the resource. The solution is common investment and common use. The commons sector must invest in the provision of non-rival ecosystem services and in green technologies that help provide and protect such services. Everyone would be free to use the non-rival ecosystem services but not to degrade the ecosystem structure that sustains them. Resources for investing in non-rival resources can be obtained from auctioning off access to rival resources. For example, society could auction off the right to greenhouse gas absorption capacity and then invest the revenue in carbon-free energy technologies. When a resource is privately owned but generates economic rent, or is used in a manner that socialises costs and privatises benefits, taxation can achieve the same goals as common ownership. For example, when oil or land prices increase due to growing demand, private owners receive windfall profits that can be taxed away. Such taxes deter speculation, bubbles and busts and the economic instability they cause. Taxes can also be imposed on land conversion or resource extraction that imposes costs on others, for example by degrading ecosystem services. In both cases, such taxes can replace taxes on productive activities, such as labour. The principles behind this are 'tax what you take, not what you make' and 'tax bads, not goods'.

In principle, the public sector should be protecting common resources while at the same time allowing the functioning of private markets where they make sense—for rival and excludable goods and services. However, in many western countries the private sector has, in the view of many observers, too much influence on the political process. When governments have propertised unowned resources, they have often turned those resources over to the private sector free of charge. Not only do

governments frequently fail to capture rent, they actively turn it over to the private sector. Society should therefore create a commons sector that has an explicit, legally binding mandate to manage the wealth of nature and the cooperatively created wealth of society for the common good. We need an expanded commons sector to enhance sustainability and a just distribution of resources. Once these two goals have been achieved, the market will be far more effective in its role of allocating scarce resources towards the products of highest value, then allocating those products towards the individuals that value them the most.

In China, the problem is the reverse. There is a well-established and formerly all-encompassing commons sector, but one that attempted to also manage the production of private goods and services. The challenge is allowing the appropriate amount of private ownership and control over rival and excludable goods and services while maintaining transparent public sector management of ecosystem services and other common assets. This process was begun in 1978 with the opening of China to international trade and the development of a market economy and is continuing today.

### 3.1 *Prevailing Governance Arrangements*

Institutions such as property rights are mechanisms people create to control their use of the environment and their behaviour towards each other (Bromley 1991). They link society to nature, and have the potential to coordinate sustainable development of human and natural systems as a whole. They also have the potential to inhibit the co-evolution of the joint system and create gridlock and confusion in environmental management (Folke et al. 2007).

In the context of natural resource management and conservation, several problems are also due to 'lack of fit' or 'scale mismatches' between ecosystems and conventional institutions that manage them (Lee 1993; Costanza et al. 1998; Folke et al. 1998; Cumming et al. 2006; Guerrero et al. 2013). Here, 'scale' is

defined as the spatial, temporal or institutional dimensions used to measure and study any phenomenon (Gibson et al. 2000). The mismatch between scales is a problem of lack of fit where human institutions do not map coherently on to the biogeophysical scale of the environment. The problem of scale mismatch is pervasive, and examples include migratory marine fisheries (Berkes 2006) and 'social traps' in which the short-run, local reinforcements, guiding individual behaviour are inconsistent with the long-run, global best interest of the individual and society (Costanza 1987).

Mismatches between the scales of social institutions and ecological systems can contribute to the mismanagement of ecosystems and a lack of an appropriate monitoring frameworks and enforcement frameworks. Climate change and oceanic fisheries are perhaps the best known examples. As a result, inefficiencies occur, important components of the systems are lost and/or functions of the social-ecological system are disrupted (Cumming et al. 2006). The loss of ecosystem services is an example of such a disruption.

Ecosystem services have different spatial scales, and one way of classifying them is by their spatial characteristics (Costanza 2008). For example, services like carbon sequestration are at a global scale, and habitat or refugia services are normally provided at a local scale. Urban green spaces provide both these services, and they are also characterised by large spatial heterogeneity and rapid changes (Pickett et al. 2001). Traditional institutions fail to match these scales and, consequently, the capacity of urban social-ecological systems to cope with future global changes is degrading (Borgstrom et al. 2006).

Conventional institutions in China and in the United States represent two different approaches to governance and scaling: mono-centric vs multi-level (Termeer et al. 2010). The former refers to an institutional setting in which the state is the centre of political power and authority that exerts control over other sectors. It does so by setting the agenda and policy goals and by top-down implementation of its policies (Kooiman 2003). In the latter, governance is characterised by continuous

interactions among governments and private entities, operating at, and between multiple administrative levels (Termeer et al. 2010).

The monocentric approach of environmental governance in China is reflected in the design and implementation of the largest payment for ecosystem services (or 'ecocompensation' as the Chinese call it) program in the world. The central government plays a key role in establishing institutional and policy schemes, and provides support for large-scale programs such as the National Forest Conservation Program and the Grain to Green Program (Zhen & Zhang 2011). On the other hand, it would probably be more productive to conduct system planning at multiple government levels. This requires overall strategic planning at the central government level and detailed planning at the local government level with a better integration of the two (Liu et al. 2008).

Sub-national climate change policies demonstrate the multi-level governance approach in the United States. Although there is no US federal participation in the Kyoto Treaty, the implementation of climate change policies at state, regional and municipal levels of government has been shown to be widespread, covering more than half the country by gross domestic product (GDP) (Fisher & Costanza 2005; Koehn 2010). On the other hand, fine-scale decisions hardly add up to the kind of cohesive action that is required for broad-scale ecological management. Key decisions may be made by individuals acting in their own interests rather than in a coordinated manner (Cumming et al. 2006).

#### 4. Needed Adjustments

Regardless of the dominant model of environmental governance one starts from, in an increasingly diverse, interdependent and multi-scale world, governance must adapt. The dichotomy of monocentric or multi-level governance is clearly inadequate in providing viable management solutions to address the multi-scale nature of ecosystem services. Politically feasible adjustments are required to manage the joint ecological-social system in a

sustainable manner. Environmental governance in China, for example, is at an early stage of transformation from the traditional command and control model to a model that emphasises the advantages of economic incentives and encourages the participation of the public (Liu et al. 2010).

Proponents of monocentric governance prefer to find solutions in a further clarification of responsibilities or in a structural change such as amalgamation (Termeer et al. 2010). In China, lower level environmental protection bureaus (EPBs) formally report to higher level EPBs, yet the funding and supervisory functions are provided by the provincial or lower level administration. This problem in organisation has been exacerbated by the higher priority given to economic growth over environmental protection. At the same time, more than 2,500 different environmental units at the county, municipal, provincial and state level struggle to address problems that are often trans-boundary in nature. To cope with this problem, an intergovernmental report recommended creating a direct line of authority between provincial and local environmental EPBs and consolidating the local EPBs at the metropolitan level for all major urban centres (Task Force on Environmental Governance 2006).

Key concerns for the multi-level approach are a lack of coordination and the potentially high costs associated with coordinating multiple actors at different levels (Hooghe & Marks 2003). For example, a recent assessment of global water markets found that there has been a limited interaction among interstate water basin agreements, and that in the western United States, trades primarily occur within river basins or sub-basins (Grafton et al. 2011). Ruhl et al. (2007) suggest that a cure for the coordination problem is the development of institutions for coordination of ecosystem resources management and for regulation of natural capital and the provision of ecosystem services as public goods. Under this proposal, Regional Ecosystem Resources Coordination Agencies would be organised as far as possible along biogeographical or watershed boundaries, instead of political

ones. This has been done in Australia since the late 1990s. The 56 natural resource management groups that cover all of Australia are based on catchment boundaries and are responsible for managing natural resources. The idea of common asset trusts, like that being proposed in Vermont, is also a variation on this theme.

Apart from these adjustments and refinements over the two existing governance approaches, another option is to establish a third type of governance that can adapt to the complexity of dynamic social-ecological systems over time. Adaptive governance is a systematic approach to improving the management process and accommodating changes by learning from the outcomes of a set of environmental policies and practices (Holling 1978; Walters & Hilborn 1978). Rooted in both the ecological system and institutional theory (Cook et al. 2010), adaptive governance has been proposed as an integrated and multidisciplinary approach for confronting complexity and uncertainty in natural resources management (Costanza et al. 1998; Folke et al. 2002). For example, the Murray Darling Basin Authority in Australia has developed an adaptive planning and management approach to water management through its Basin Management Plan (Murray-Darling Basin Authority 2011).

In contrast to monocentric and multi-level governance, adaptive governance has three characteristics. First, adaptive governance relies on the concept of resilience as a fundamental organising principle (Olsson et al. 2004). Second, the concept of scale is not constrained to spatial and jurisdictional scales alone (Termeer et al. 2010). Other dimensions considered include temporal, institutional, management, network and knowledge scales (Cash et al. 2006). Finally, adaptive governance also emphasises cross-scale and cross-level interactions, where level is defined as the units of analysis that are located at different positions on a given scale (Gibson et al. 2000). For this reason, institutional interplay and co-management have been put forward to facilitate solutions to complex environmental problems that decision-makers have historical difficulty in solving (Cash et al. 2006).

The key to achieving sustainable governance in our complex, interdependent world is an integrated (across disciplines, stakeholder groups and generations) approach based on adaptive governance. Six core principles (the Lisbon Principles) that embody the essential criteria for sustainable governance have been proposed (Costanza et al. 1998). The six Lisbon Principles together form an indivisible collection of basic guidelines governing the use of common natural and social capital assets.

- **Principle 1: Responsibility.** Access to common asset resources carries attendant responsibilities to use them in an ecologically sustainable, economically efficient and socially fair manner. Individual and corporate responsibilities and incentives should be aligned with each other and with broad social and ecological goals.
- **Principle 2: Scale matching.** Problems of managing natural and social capital assets are rarely confined to a single scale. Decision-making should: (i) be assigned to institutional levels that maximise input; (ii) ensure the flow of information between institutional levels; (iii) take ownership and actors into account; and (iv) internalise costs and benefits. Appropriate scales of governance will be those that have the most relevant information, can respond quickly and efficiently, and are able to integrate across scale boundaries.
- **Principle 3: Precaution.** In the face of uncertainty about potentially irreversible impacts to natural and social capital assets, decisions concerning their use should err on the side of caution. The burden of proof should shift to those whose activities potentially damage natural and social capital.
- **Principle 4: Adaptive management.** Given that some level of uncertainty always exists in common asset management, decision-makers should continuously gather and integrate appropriate ecological, social and economic information with the goal of adaptive improvement.
- **Principle 5: Full cost allocation.** All of the internal and external costs and benefits,

including social and ecological, of alternative decisions concerning the use of natural and social capital should be identified and allocated. When appropriate, markets should be adjusted to reflect full costs.

- **Principle 6: Participation.** All stakeholders should be engaged in the formulation and implementation of decisions concerning natural and social capital assets. Full stakeholder awareness and participation contributes to credible, accepted rules that identify and assign the corresponding responsibilities appropriately.

## 5. Conclusions

There is huge and growing interest and need in the United States, China and around the world for better management and governance of all of our assets but especially our natural and social capital. China's recent development path has replicated the Western model of rapid GDP growth with little concern for environmental and social externalities. But that situation seems to be changing, partly as a result of the kinds of studies referred to in this article. As China, the United States and the rest of the world increasingly recognise the value of natural and social capital, they can begin to pursue a more balanced and sustainable development path. China can build on the Confucian ideals of 'Xiao Gang' (a society in which all people are able to live relatively comfortably) or 'Da Tong' (the 'great unity' where everyone works together to share the commons) or the more recent 'harmonious society', a hallmark of Hu Jintao's socioeconomic vision, which calls for a fundamental shift in China's policy focus from economic growth to social fairness and environmental protection. Both the United States and China can build on these ideas to develop an ecological economy, where both private and public goods (including natural and social capital) are valued and managed appropriately and in the right balance to achieve a sustainable and desirable future.

*Final version accepted November 2013.*

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