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Ostrom, Hardin and the commons: A critical appreciation and a revisionist view

Eduardo Araral *

Lee Kuan Yew School of Public Policy, National University of Singapore, 469C Bukit Timah Road, Singapore

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ABSTRACT

I provide a critical appreciation of the considerable legacies of Ostrom and Hardin to the literature on the commons. First, how valid is Ostrom's critique of Hardin's tragedy of the commons? Second, how generalizable is Ostrom's institutional design principles for long-lived commons? Finally, how justified is Ostrom's critique of privatization, markets and the Leviathan solutions to the tragedy of the commons? Based on a reassessment of the evidence and reinterpretation of Ostrom's work supplemented by field work, my preliminary findings suggest that, first, her critique of Hardin is valid in the special case of small-scale, locally governed commons while Hardin seem justified for large scale, national, regional and global commons. Second, studies arguing for the generalizability of Ostrom's institutional design principles have methodological issues and more rigorous studies are needed. Finally, Ostrom is justified for her critique of the Leviathan solution to the tragedy of commons but a rethinking is needed of her critique of private property rights and markets. I conclude by acknowledging a debt of gratitude to Ostrom for laying the foundations for the third generation research agenda on the commons and inspiring a new generation of scholars.

1. Introduction

This volume is dedicated to a critical appreciation – or interrogation as the theme suggests – of the considerable legacies of Ostrom and Hardin have made in environmental governance, particularly in the commons literature. I explore three questions toward this end. First, how valid is Ostrom's (1990) critique of Hardin's tragedy of the commons? Second, how generalizable is Ostrom's (1990) institutional design principles for long-lived commons? Finally, how justified is Ostrom's (1990) critique of privatization, markets and the Leviathan solutions to the tragedy of the commons? I submit that these questions are important in revitalizing the commons research program and as an impetus toward a third generation research agenda.

Based on a reassessment of the evidence and Ostrom's (1990) work as well as a revisit to one of Ostrom's case studies, my preliminary findings suggest that, first, her critique of Hardin is valid in the special case of small-scale, locally governed commons while Hardin seem justified for large scale, national, regional and global commons. Second, studies (i.e. Cox et al., 2010) arguing for the external validity of Ostrom's institutional design principles are flawed. Finally, Ostrom is justified for her critique of the Leviathan solution to the tragedy of commons but a rethinking is needed of her critique of private property rights and markets.

Common pool resources or CPRs are goods – manmade or natural – large enough in which exclusion from the resource system is costly but consumption of a resource unit is rivalrous (i.e. no longer available to others). Excludability and rivalry are two features that distinguish common goods,

* Tel.: +65 96413107.
E-mail addresses: sppaej@nus.edu.sg, ekararal@hotmail.com.
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public goods, private goods and toll goods. Private goods are rivalrous in consumption by exclusion is feasible. These two characteristics makes CPRs susceptible to overharvesting and destruction, hence the so-called tragedy of the commons. The excludability of the commons depends among others on the enforceability of rules and property rights (Ostrom, 1990). This in turn depends on the technology and cost of exclusion, which in turn is affected by a host of variables including group size, heterogeneity of interests and various characteristics of the resource – for instance whether it is stationary (forest), mobile (fisheries), difficult to monitor (ground water), among others.

In the legal literature, commons or *res commune*, are defined as "things common to all; that is, those things which are used and enjoyed by everyone ... but can never be exclusively acquired as a whole" (Black Dictionary of Law, 1990). It is important to note that this legal definition applies in particular to the resource system – forestry ecosystem, marine and coastal ecosystem, irrigation system, grazing land, oceans and watersheds which are used and enjoyed by everyone – but not to the units from that resource system such as woods, fisheries, water, all of which are rivalrous. For example, some CPRs such as forests are characterized by both subtractibility (wood, resin, fruits) and non-subtractability (water supply, flood control, pollution and climate control).

The paper is organized as follows. The next part summarizes the three main legacies of Ostrom to environmental governance. This is followed by an in-depth review of the evidence and discussion of the questions I have set out to explore. I conclude with implications for a third generation research agenda on the commons.

2. Ostrom's legacies to environmental governance

Ostrom has at least three major and interrelated legacies to environmental governance: (1) as a critique of Hardin; (2) for establishing an international research agenda to identify the determinants of collective action in the commons; and (3) for establishing the Bloomington School of institutional analysis otherwise known as the Ostrom Workshop. I discuss them in reverse order of significance.

2.1. *Critique of Hardin*

As is widely known, Ostrom and her colleagues overturned the conventional wisdom of Hardin's tragedy of the commons and the commons as a prisoner's dilemma by showing that tragedy is not inexorable and cannot be generalized. She and her colleagues concluded that the drama of the commons – so called because of evidence of both successful and failed governance – would be a more appropriate narrative (NRC, 2002; Feeny et al., 1990). There is a consensus in the literature regarding the drama of the commons but as I will argue in the next section, this is a special case for small-scale, locally governed commons.

However, I regard this as the least important of her legacies because it is easy enough to point to the flaws of these metaphors. For one, the prisoner's dilemma assumes that the prisoners cannot communicate. Second, Hardin assumed that tragedy is inexorable and that resource users are trapped in a tragedy. Many scholars have already shown that these assumptions do not hold in the real world, for instance Siy (1980), Netting (1976) and McKean (1982). However, their work did not receive adequate attention. One of Ostrom's main contributions in the literature is to bring these disparate case studies together, carefully select them to test her hypotheses about the evolution of institutions for collective action overtime, point to the similarities of the institutional dilemmas plaguing the commons, extrapolate the design principles of long lived commons and show why Hardin's conclusion is flawed.

2.2. *Second generation research on the commons*

Ostrom's second – and more important – legacy to environmental governance is to inspire a generation of scholars of the commons – myself particularly[1] – to understand why certain commons have managed to overcome tragedy while others have not. Inspired by her institutional design principles for long-lived commons, these scholars and professionals have set out in the next two decades to identify, compare and catalog a wide range of variables and hypotheses that affect the outcomes of the commons (see for example, Author's name withheld, 2002; NRC, 2002; Cox et al., 2010; Behera, 2009; Bastakoti et al., 2010; Andersson, 2012; Gorton et al., 2009; Coulibaly-Lingani et al., 2011; Ito (2012), among others). For a synthesis of the literature, see Ostrom and Van Laerhoven (2007) and for a summary of the research hypotheses coming out of the literature, see NRC (2002).

Based largely on field work, multi-method and multi-disciplinary approaches, this research agenda covered, for instance, governance of fisheries in Maine and Mexico, ancient irrigation in Nepal, Arizona, Spain and the Philippines; forestry in India, Nepal, Guatemala, Colombia, Bolivia; pasture in Kenya; wildlife in East Africa; public housing in China and ground water in California, knowledge commons, among others. The apex of this second-generation research agenda on the commons is the creation of International Association for the Study of the Commons, the main international professional and scholarly society on the commons, with Ostrom as its founding President.

This second legacy is more important than pointing to the flaws of Hardin's metaphor because it helped lay the foundations for a robust empirical research agenda on the commons that has already run for more than 25 years and likely to continue after Ostrom. In essence, this second legacy emphasizes the importance of a nuanced and diagnostic approach to the study of the commons. This approach pays attention to the incentives of actors and how a host of independent, moderating and intervening variables influences these incentives.

These set of variables that have been identified in the literature in the last 20 years include the characteristics of the common pool resource (CPR), the attributes of the resource

[1] Ostrom was my PhD supervisor, mentor, and long time friend, along with Vincent Ostrom. My family and I also lived and worked with the Ostrom from 2002 to 2006.

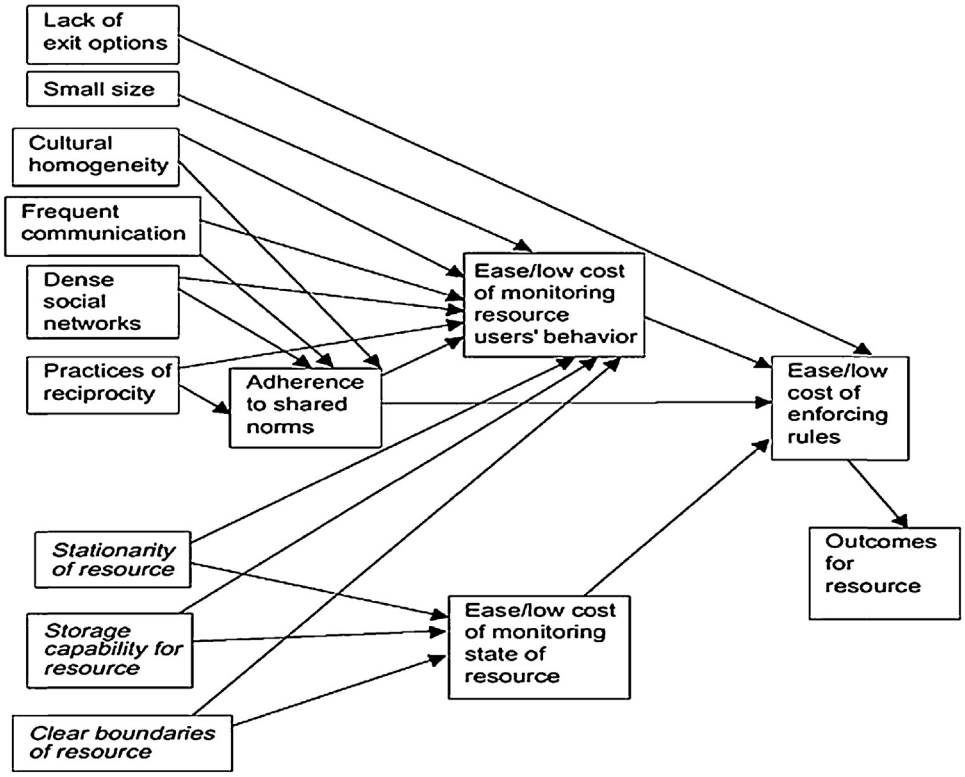

Fig. 1 – Postulated effects of variables on the outcomes of the commons.
Source: **NRC (2002).**

users and the institutional context. The characteristics of the CPR that have been posited in the literature to affect outcomes in the commons include the excludability and rivalry of the CPR, renewability, mobility, stationarity, the distinction between resource systems as commons and their resource units, clarity of boundaries.

On the other hand, the attributes of the resource users posited to affect outcomes in the commons include group size, cultural homogeneity, social capital or density of social networks, practices of reciprocity and the salience of the resource or lack of exit options for the resource users (NRC, 2002). Fig. 1 summarizes the postulated effects of these variables on the outcomes of the commons. Finally, the institutional factors that affect outcomes in the commons that have been studied in the literature includes the clarity and enforceability of property rights, as well as the mechanisms – formal and informal – for the supply, monitoring and enforcement of rules.

Ostrom no doubt played a central role in inspiring this second generation of scholars who have set out to empirically study the determinants of collective action in the common and their contributions in turn have provided the foundations for future empirical work.

2.3. *The Ostrom school of thought*

Finally, Ostrom's third and perhaps most important legacy – along with Vincent Ostrom and their colleagues – is the development, testing and refinement of conceptual frameworks, theories, models and methods to become what can be called the Bloomington School of Institutional Analysis. This legacy in fact extends far beyond the commons literature as described by Aligica and Boettke (2009) as follows:

> *"The Bloomington School has become one of the most dynamic, well recognized and productive centers of the New Institutional Theory movement. Its ascendancy is considered to be the result of a unique and extremely successful combination of interdisciplinary theoretical approaches and hard-nosed empiricism. The Bloomington research agenda is an attempt to revitalize and extend into the new millennium a traditional mode of analysis illustrated by authors like Locke, Montesquieu, Hume, Adam Smith, Hamilton, Madison and Tocqueville. As such, the School tries to synthesize the traditional perspectives with the contemporary developments in social sciences and thus to re-ignite the old approach in the new intellectual and political context of the twentieth century."*

Indeed, Ostrom's legacy cannot just be confined to environmental governance. The Ostrom workshop, in fact, introduced frameworks, theories and models that have helped foster a conversation amongst social science scholars and ecologists (see McGinnis, 2011 for a summary). Below I explore some of these major ideas and their implications to environmental governance.

2.3.1. *Second generation theories of collective action*

Ostrom is the acknowledged champion of the second-generation theories of rational choice and collective action (Ostrom, 1998) and she has illustrated these with her work on

the commons. This family of theories challenged the first generation theories of collective action typified by Hardin's tragedy of the commons, Olson's theory of groups and the canonical Prisoner's Dilemma which all assumed a tragic outcome in the commons.

In brief, the second-generation theories suggest the possibility of self-governance as a viable solution to collective action problems in the commons.

Indeed, in the context of the panaceas of markets and the Leviathan State, the possibility of self governance has a powerful intuitive appeal: if rational, self-interested individuals and countries can learn to trust each other, then the problem of collective action in the commons need not become inexorable.

The second-generation theories point to the centrality of trust and reciprocity as the core determinant of collective action not only in the commons but of the evolution of social order more generally (Fig. 2).

Ostrom (2003) points out that the extent of cooperation in the commons is a function of two core variables: trust and reciprocity. Trust in turn is a function of reputation as well as information about the past actions of the actor, which in turn is a function of face-to-face communication, which in turn depends on small group size. Face to face communication affects the cost of arriving at agreements as well as the development of shared norms, which in turn determines the extent of reciprocity. Besides norms, reciprocity is a function of the discount rate of the appropriator of the resource, which in turn is a function of the degree of certainty or uncertainty about the resource and the behavior of resource users. Uncertainty in turn is positively correlated with discount rates (i.e. higher uncertainty, higher discount rates). For example, when there is high uncertainty about the availability of the resource (for instance groundwater) or resource users are unable to make credible commitments, it is likely that there will also be a high discount rate among resource users thereby increasing the likelihood of resource degradation.

2.3.2. *Polycentricity*

A second and important contribution of the Ostrom workshop is their work on polycentricity. McGinnis (2011) defined polycentricity as "a system of governance in which authorities from overlapping jurisdictions (or centers of authority) interact to determine the conditions under which these authorities, as well as the citizens subject to these jurisdictional units, are authorized to act as well as the constraints put upon their activities for public purposes."

The original definition of polycentricity was advanced by Vincent Ostrom as follows: "a polycentric organization has been defined as a pattern of organization where many independent elements are capable of mutual adjustment for ordering their relationships with one another within a general system of rules" (Ostrom 1972, in McGinnis, 1999, p. 73).

Polycentricity has a powerful implication for institutional analysis and design in general and environmental governance in particular: environmental governance is not just about markets and states but should recognize the diversity of possible institutional arrangements to solve environmental problems at various scales: By diversity, I mean multi-level, multi-purpose, multi-sectoral and multi-functional units.

McGinnis (2011) described these units of governance as follows: multilevel units of governance involve local, provincial, national, regional, global units. Multi-purpose governance involves general-purpose nested jurisdictions (as in traditional federalism) as well as special purpose, cross-jurisdictional political units (such as special districts). Multi-sectoral units of governance include public, private, voluntary, community-based and hybrid kinds of organizations. Finally, multi-functional governance incorporates specialized units for provision (selection of goals), production (or co-production), financing (taxes, donors), coordination, monitoring, sanctioning, and dispute resolution.

At its core, the necessary preconditions for polycentric order for a political system as a whole – a compound republic according to Vincent Ostrom – include "polycentricity in the organization of (1) market arrangements; (2) the legal community; (3) constitutional rule; and (4) political conditions [selection of political leadership and formation of political conditions]."

Few studies on environmental governance have so far implicitly used polycentricity as their framework of analysis despite its potential. Health care, energy, climate change, the

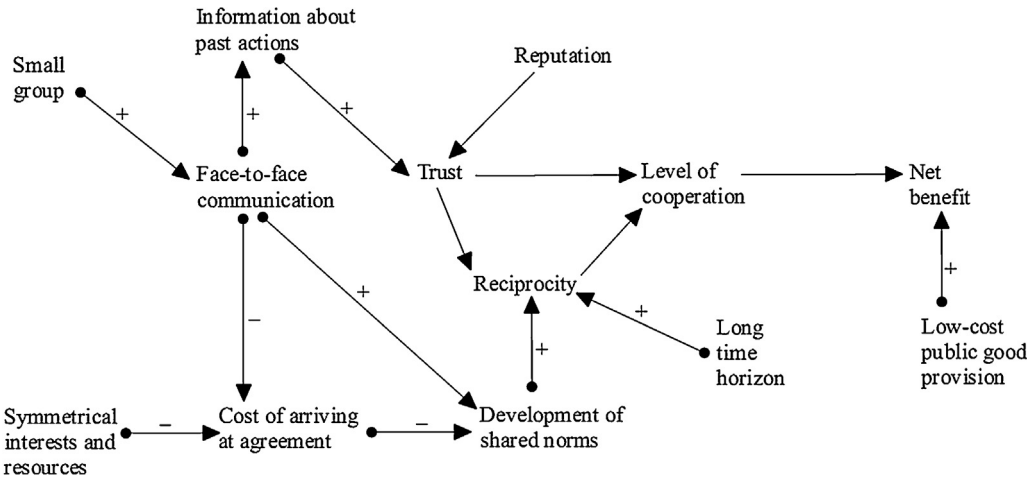

Fig. 2 – Toward a general theory of collective action.
***Source*: Ostrom (1998).**

commons, and urban services are some of the areas where the idea of polycentricity has been studied. Sovacool (2011), for instance, employed polycentric analysis to climate and energy governance. Conceivably, the notion of polycentricity can also be applied to a variety of environmental problems in large federal types of governments particularly those involving multiple jurisdictions such as water and air pollution, climate change, wildlife management, acid rain, watershed, among others.

Having outlined three of Ostrom's legacies and their implications to environmental governance, I now set out to investigate the following research questions I have set up to answer in this paper. To repeat, these questions are as follows: first, how valid is Ostrom's critique of Hardin's tragedy of the commons and could Hardin actually be correct? Second, how valid is Ostrom's institutional design principles for long-lived commons? Finally, how valid is Ostrom's critique of privatization and the Leviathan as a solution to the tragedy of the commons?

3. How valid is Ostrom's critique of Hardin?

An extensive and critical review of the commons literature in the last 20 years would suggest that Ostrom's critique of Hardin should be qualified as a special case for small scale and locally governed commons but not a general case. Indeed, most of the empirical and meta-analytic studies supporting Ostrom's critique of Hardin – and the drama of the commons narrative – were based on small-scale, locally governed commons, which have been relatively insulated from external factors and rapid state of change.

This literature, for instance, include Ostrom's (1990) 15 original case studies; Schlager (1994); McKay (1996); Agrawal (2002); Bardhan (2002); Lam (1998); McKean (1982); Araral (2009); Tang (1992); Berkes (1992); Varughese and Ostrom (2001); Schlager (1994); Dayton-Johnson (2000) and in particular, Cox et al. (2010) based on a meta-analysis of 168 case studies on the commons which examined the external validity of Ostrom's institutional design principles.

Compared to local commons, very few scholars have picked up the research agenda on the global commons. There are exceptions, of course but these are small in number compared to the study of local commons. For instance, Gibson et al. (2000) surveyed the concept of scale and the human dimensions of global change. They wonder whether lessons learned about institutions at one level of social organization transfer to other levels because the actors at different levels are not completely analogous, so transferability should be expected to be imperfect. Stern (2011) proposed a set of design principles to manage the global commons while Young (1994, 1999) argued for the possibility of governing the global commons in a stateless world.

Dietz et al. (2003) also attempted to propose strategies to deal with problems of the global commons. These strategies include for example, ''dialog among interested parties, officials, and scientists; complex, redundant, and layered institutions; a mix of institutional types; and designs that facilitate experimentation, learning, and change'' (Dietz et al., 2003). They concluded that if these conditions are met, there are reasons for ''guarded optimism'' in the global commons.

4. Could Hardin be correct?

Could Hardin be correct about his metaphor of the tragedy of the commons?

In this section, I will provide the theoretical and empirical arguments why Hardin's pessimism in the commons can be justified in the case of large scale, national and global commons. National commons refer to common pool resources within the sovereign jurisdiction of a country such as China's Yellow River. Regional commons refer to resources that transcend several countries such as the Mekong, Nile and Ganges Rivers. Global commons refer to those resources that are outside the jurisdiction of any country or groups of countries. The main trait of these commons is that exclusion from the resource system is relatively difficult compared to the local commons.

4.1. *Diagnostic framework*

Ostrom (2007) and her colleagues (Anderies et al., 2003) proposed a diagnostic framework to study ''complex, multivariable, nonlinear, cross-scale, and changing socio-ecological systems.'' The framework is designed to enable scholars to go beyond panaceas of markets and Leviathan to solve the tragedy of the commons. This framework provides for a nested and multitier approach that brings together four categories of variables: (1) the characteristics of the resource system and resource units; (2) attributes of user groups and (3) the governance system ''jointly affect and are indirectly affected by interactions and resulting outcomes achieved at a particular time and place.'' This framework provides a much more nuanced approach to the diagnoses of problems in the commons than Hardin's simplistic metaphor of tragedy of the commons.

For instance, the framework is useful in understanding the different dynamics between local and global commons. In the former, the actors are individuals while in latter the main actors are nation-states represented by a collection of political actors who are trying to maximize their constituencies self interests to secure their own political survival. This makes it difficult (though not impossible) to find a common ground among nation-states to cooperate in conserving the global/regional commons. The case of post Kyoto treaty negotiations for climate change is a good example. Likewise, the case of the Mekong River – in which China, which controls the headwaters, is reluctant to bind itself to the rules of the Mekong River Commission – is another good example of the difficulty of cooperation in a regional commons in the presence of asymmetric power relations. At the rate that these commons are degraded and the rate that they are renewed or replenished, there seem to be theoretical grounds for Hardin's pessimism. In Section 4.2 below, I examine whether theory is supported by empirical evidence.

Furthermore, although the theoretical dilemmas of local and global commons are similar – i.e. potential for free riding, congestion, over expropriation, credible commitment issues,

monitoring and enforcement – the issue of scale, transaction costs, nature of the players and the ensuing wickedness of collective action problems supports the case for pessimism for large-scale national, regional and global commons. This view provides a realist perspective of the global commons.

Stern (2011) provides a cogent theoretical explanation for why cooperation in the global resource commons is different from that of the local commons. He differentiated local and global commons in terms of geographic scale, number of users, salience or actor's awareness of degradation, distribution of interests and power, cultural and institutional homogeneity, feasibility of learning, regeneration of degraded resource, feasibility of learning, ease of understanding resource dynamics and stability of resource dynamics. Stern then outlines the challenges in applying Ostrom's design principles to the global resource commons. These challenges include: devising rules congruent with ecological conditions, defining boundaries for resources and appropriators, monitoring and enforceability of rules, the size of appropriators, disconnect between users and losers of resource use, science may not be credible to stakeholders, among others.

Stern concludes that managing the global commons requires a different set of governance principles compared with the local commons. These include: (1) investing in science to understand the resource and its interactions with users and those affected by its use; (2) establish independent monitoring of the resource and its use that is accountable to the range of interested and affected parties; (3) ensuring meaningful participation of the parties in framing questions for analysis, defining the import of scientific results, and developing rules; (4) integrating scientific analysis with broadly based deliberation; (5) higher-level actors should facilitate participation of lower-level actors; (6) engage and connect a variety of institutional forms from local to global in developing rules, monitoring, and sanctioning and (7) plan for institutional adaptation and change.

4.2. *Pessimism or optimism?*

There is some evidence to support Hardin's pessimism in the case of global commons although tragedy is not inexorable and guarded optimism is highly conditional. Examples of tragedies of the global commons include the unsustainable pumping of groundwater in rural India (Pearce, 2007) and Northern China; the unabated destruction of corals and overfishing in the coral marine triangle – the so-called Amazon of the seas – in the southeast Pacific Ocean; the massive degradation of the marine ecosystem in the South China sea (Hughes et al., 2012); the problem of collective action and hydro-hegemony in the Mekong River; the water crises in Northeast China (Xie et al., 2009); the collapse of the Aral sea in Central Asia, regarded as one of the world's worst environmental disasters (Micklin and Aladin, 2008); the unabated degradation of forests in Kalimantan in Indonesia; and, the unregulated use of the global atmosphere and oceans as a global sink, among many other examples.

In contrast, Young (1994, 1999) provide a more nuanced and optimistic view on the governance of global commons based on regime theory. In essence, the theory argues that regime systems that govern global commons are dynamic. They evolve overtime, some successfully into problem solving organizations such as the case of the Arctic commons, Third Law of the Sea Convention, the deep seabed, whaling and marine pollution regimes, Antarctica and outer space regimes for weapons. In this sense, Young provides a liberal, constructivist and hence a more optimistic view of the global commons. In addition, there are also a handful of what can be considered as relatively successful governance of large-scale, *national and regional commons:* China's Yellow River Basin (Giordano et al., 2004); Colorado Riverbasin, the Murray Darling Basin in Australia (MDBA, 2013), and cooperation in the Arctic (Young, 1994). Strictly speaking, however, these are not open access commons in the sense that property rights to these resources are relatively well defined and exclusion to the resource system and resource unit is feasible.

Treaties usually – but not necessarily – govern regional and global commons, for example the UN Convention on the Law of the Seas (UNCLOS) and the Convention on Biodiversity (CBD). The aim of UNCLOS, as summarized in its preamble, is to create "a legal order for the seas and oceans which will facilitate international communication, and will promote the peaceful uses of the seas and oceans, the equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection and preservation of the marine environment.

However, Clancy (1998) has argued that UNCLOS has done little to conserve the global commons because its key provisions instead encourage their exploitation rather than their conservation with the benefits enjoyed only by select states. For instance, the UNCLOS allows for the Exclusive Economic Zone (EEZ), which stretches 200 nautical miles from a country's coast. EEZ grants sovereign rights to the coastal state for exploitation of living and nonliving natural resources therein, and it makes the promotion of "optimum utilization a mandatory obligation."

Although the possibility of forging a cooperative solution among competing parties cannot be fully discounted overtime, the likelihood of the development of robust governance arrangements for the global commons is much lower than the rate at which the CPR units and resource systems are degraded and replenished. For instance, significant international efforts to rehabilitate the Aral Sea have not yielded significant results in the last 20 years. The Mekong River Commission in Southeast Asia has been around for 52 years but will remain less than effective without the participation of China, which controls the headwaters and do not want to submit itself to the norms and rules of the Commission. China has gone ahead to build dams in its part of the Mekong, which critics say could harm its ecosystem.

Moreover, after 15 years since it went to force, China and the United States still refuse to bind themselves with UNCLOS for strategic and security reasons. This problem highlights a core dilemma of collective action for the global commons in the presence of the US as a hegemon and a rising power such as China. Clearing of tropical forests in Indonesia continues unabated despite the much talked about REDD mechanism and the USD 1 billion that Norway has promised Indonesia in return for protecting its forests. There is no also end in sight to the rapid depletion of ground water in India and Northern

China. The water conflicts in Central Asia – between Uzbekistan and Tajikistan over the construction of the Ragun Dam – are unlikely to be settled soon. China and India are unlikely to come to terms in the Brahmaputra River, if China's behavior in the Mekong is any indication. China is already building run of the river type projects in the Brahmaputra River to the strong objections of India.

For these reasons, I argue that Hardin's pessimism is justified given the rate of deterioration and replenishment of these large-scale commons and the rate at which competing interest groups have been unable to device effective and robust governance mechanisms to solve the wicked collective action problems associated with them. Thus, on the occasion of the 45th anniversary of the tragedy of the commons metaphor, I argue for a revisionist view that Hardin's pessimism is well founded in the case of the large scale, national, regional and global commons.

However, this revisionist view of Hardin and the qualification of Ostrom's drama of the commons as a special case do not in anyway undermine her legacy as a thought leader in the commons. In fact, as I would argue, Ostrom's more important legacy is to establish a highly successful international research agenda to identify the nuances of the commons as well as the core conditions and institutional design principles that characterize resilient and long-lived commons. I explore the external validity of these design principles in Section 5.

More importantly, Ostrom (2007) has consistently challenged the presumption "that scholars can make simple, predictive models of social–ecological systems (SESs) and deduce universal solutions, panaceas, to problems of overuse or destruction of resources." She called on scholars to go beyond panaceas of markets and Leviathan solutions and develop diagnostic capacities to tackle "complex, multivariable, nonlinear, cross-scale, and changing socio-ecological systems." As Stern (2011), an expert on global commons notes, "one of the enduring contributions of Ostrom's *Governing the Commons* to the problems of global commons is the expansion of thinking beyond the usual policy approaches of regulatory command and control, government intervention in market pricing systems, and formal agreements among national sovereigns."

5. How generalizable are Ostrom's institutional design principles?

In addition to pointing to the limitations of Hardin's narrative, Ostrom is also well known for proposing eight institutional design principles governing long-lived commons. These principles have been extensively analyzed and described by others (Cox et al., 2010) and I will just summarize them as follows: (1) well-defined boundaries; (2) congruence between appropriation and provision rules and local conditions; (3) collective-choice arrangements; (4) monitoring; (5) graduated sanctions; (6) low cost conflict-resolution mechanisms; (7) minimum recognition of rights; and (8) nested enterprises.

The design principles, Ostrom argued, provide the necessary though not sufficient conditions to solve problems of collective action in the commons, namely the need to (1) provide information about the commons and the resource users; (2) deal with conflicts; (3) induce compliance with rules; (4) provide the physical, technical and institutional infrastructure; and (5) encourage adaptation and change. Dietz et al. (2003) elaborated in Fig. 3 the causal links between the design principles and these five conditions associated with long-lived commons.

In 2010, some 20 years after Ostrom first published these design principles, Cox et al. (2010) undertook a meta-analysis – based on a study of 168 cases published after 1990 – to examine the extent to which Ostrom's design principles are supported in the empirical literature. Their main conclusion is that many of design principles have statistically significant effects on the outcomes of the commons and by implication have some external validity. For a analysis of the applicability of these principles to global commons, see Stern (2011).

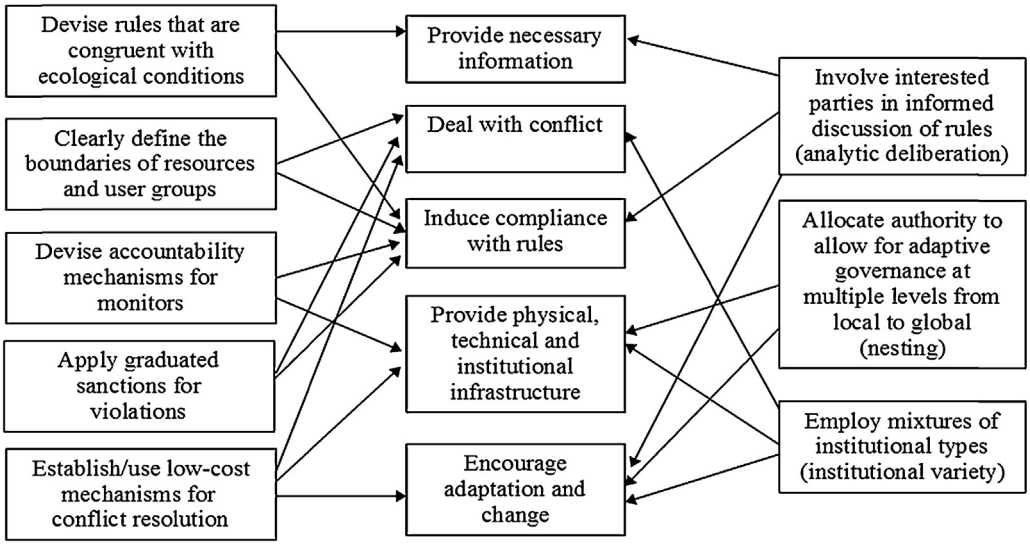

Fig. 3 – Causal relations between institutional design principles and the five problems of collective action in the commons. *Source*: Dietz et al. (2003).

An evaluation Cox et al.'s their study, however, suggests four potentially serious methodological issues that could threaten the validity of their conclusion: (1) the extent of confirmatory bias among the case studies; (2) endogeneity; (3) specification problem; and (4) multi-co-linearity. At the onset, it has to be made clear that these criticisms apply only to the study of Cox et al. and its conclusion about external validity (or generalizability) of these design principles. There is no question about the internal consistency or coherence of Ostrom's institutional design principles, which are supported by detailed, coherent and plausible arguments backed up by rigorously selected case studies.

5.1. *Confirmatory bias*

The first potentially serious problem to the conclusion by Cox et al. is the problem of confirmatory bias amongst the case studies they used in their analysis. Cox et al. used case studies published after Ostrom's design principles. As Ostrom gained international reputation, so did these design principles.

One would wonder then to what extent were the findings of these post 1990 case studies the result of a confirmatory bias – what I would call the "Ostrom halo effect" – especially when few of them offered rigorous counterfactuals to rule out other potential explanatory variables? To be fair, there were some rigorous case studies in the dataset, but their small number limits their statistical power. The inclusion of impressionistic case studies – even with the use of double refereeing – remains problematic because of the well-known problem of extremeness aversion, i.e. avoiding extreme options such as 1 and 5 in a five point ordinal scale.

5.2. *Specification problem*

A second serious concern in the study of Cox et al. is the problem of specification. I illustrate this with two examples. First, Cox et al. (2010) defined the design principle of clear boundary rules in terms of community and resource boundaries. However, in the context of collective action in the commons, which is the core of Ostrom's (1990) work, well-defined boundaries refer to enforceable property rights to a resource – not community or resource boundaries as coded in the study. As the critical literature has correctly pointed out, a spatially based definition of a community is problematic. Likewise, a clear definition of the resource – as a system and as a unit – can be problematic.

For example, how were boundary rules defined in irrigation case studies? How did the authors code the community in an irrigation case study given the overlapping, fuzzy and temporal nature of rights in such a setting – i.e. there could be a community of water rights holders, land owners who live in the town center, share croppers who live in a different village, irrigation infrastructure workers who may not necessarily be land or water owners, etc. This problem is compounded in large-scale commons. This illustration highlights the amorphous meaning of community and thus the serious problem of specification that can adversely affect the regression results especially that irrigation case studies constitute a significant proportion of cases in their dataset.

The second serious case of a specification problem concerns the definition of what constitutes a successful CPR. Ostrom (1990) defined success in terms of the robustness of the institutions governing the commons. By this, she meant "institutions that enable individuals to achieve productive outcomes in situations where temptations to free ride and shirk are ever present" (Ostrom, 1990, p. 15). In the dataset used by Cox et al., there is no common definition of success. Few of the case studies they examined are comparable to Ostrom's method of rigorous case selection and only a few used Ostrom's definition of success cited above.

Other scholars who conclude that the governance of the CPR is relatively successful have used different measures of success. For instance, Lam (1998) used agriculture production data. Araral (2009) used irrigation performance metrics. Alston and Andersson (2011) used transaction cost in the case of REDD. Local resource users are also likely to have their own definition of success, i.e. in terms of fairness, livelihoods, social relations, among others.

5.3. *Multi-collinearity*

Third, there is also the question of how Cox et al. dealt in their regression models the strong possibility of multi-co-linearity amongst the eight design principles. For instance, principles 1, 2, 4, 5 and 6 are likely to have a co-linear effect and thus could undermine the reliability and validity of the regression results. Just to illustrate, the principles of monitoring, graduated sanctions and conflict resolution mechanisms (principles 4–6) are all co-linear – each principle depend on one another. You cannot have sanctioning or effective conflict resolution mechanisms without effective monitoring. Effective conflict resolution mechanisms – for instance low transaction cost – also depend on the clarity of boundaries (principle 1), cost of monitoring and the nestedness (principle 8) of the social structure. Collinearity problem undermines the reliability and validity of the regression results.

5.4. *Endogeneity problem*

Finally, there is also the problem of endogeneity. Were the case studies successful because of the design principles or could it be that their initial success led to the development and subsequent reinforcement of these design principles to reinforce their initial success? What about case studies that did not survive overtime and therefore cannot be observed as counterfactual to successful cases? Are cases pre-selected according to the prevailing theory? The Cox et al. paper was not clear about these issues.

In conclusion, and to be fair, Ostrom was herself tentative in her conclusions about the design principles and has consistently called on other scholars to revisit the study sites, study them overtime and to undertake more rigorous studies.

6. How valid is Ostrom's (1990) critique of privatization and the Leviathan?

The citation for Ostrom's Nobel Prize in economics reads as follows: "(Ostrom) has challenged the conventional wisdom

that common property is poorly managed and should be either regulated by central authorities or privatized.'' In this section, I argue and show – based on a reassessment of Ostrom's work and a field work to one of her successful examples of the commons – that Ostrom is justified on her critique of state regulation but I submit that her critique on the efficacy of private property regimes in the commons needs some rethinking but I also offer a caveat to this in the concluding section.

First, some conceptual definitions are needed on what I refer to as private property and CPRs. In the 1990s, there has been much confusion and debate among scholars on what is meant by CPRs (see for example Schlager and Ostrom, 1992). Today, there is a general agreement among scholars – property theorists, legal scholars, commons scholars and economists – that the fundamental difference between CPRs and private property regimes is in their excludability and rivalry in consumption. The US National Research Council (NRC, 2002) has captured this consensus based on a synthesis of the literature which Ostrom and Ostrom (1977) elegantly illustrated in Fig. 4.

As earlier defined by Ostrom, commons are ''goods large enough in which exclusion to the resource system is costly but consumption of a resource unit is rivalrous (i.e. no longer available to others).'' As previously pointed out, in legal parlance, commons or *res commune*, are defined as ''things common to all; that is, those things which are used and enjoyed by everyone ... but can never be exclusively acquired as a whole'' (Black Dictionary of Law, 1990). In this paper, I follow this established definition of private property and CPR.

In essence, Ostrom criticized proponents of privatization of the commons, for instance Demsetz (1967) among others, who suggested ''the only way to avoid the tragedy of the commons is to end the common-property system by creating a system of property rights'' (see Ostrom, 1990, p. 12). Ostrom's criticism of the limitations of private property rights in the commons is based on her assumption of what most analysts mean when they refer to the need to develop private rights in the commons. By this she meant, in the case of land, forests and meadows, their partition into individual parcels and assigning these to individual owners who can then decide what to do with them (Ostrom, 1990, p. 12–14). She also assumed that ''even when particular rights are unitized, quantified and salable, the resource system is still likely to be owned in common rather than individually.''

This assumption appears to be the Achilles heel of Ostrom's argument. I argue that privatization of the commons need not take the form of resource systems individually owned by a person who can unilaterally decide what to do with the resource. Rather, resource systems such as land, meadows, irrigation canals and forests need not be owned by individual persons and divided into separate individual parcels. Limited access (and hence private rights) to resource systems can and do in fact take other forms of ownership such as partnerships (clubs, cooperatives, associations) and corporate entities such as cantons, corporations, local villages, or private groups. Because exclusion is feasible, access to the resource is limited and property rights are clear and enforceable, these resources no longer qualify as common pool resources. Rather, they take the form of private property owned by a collective (or partnership) in which exclusion is feasible and hence access is limited.

6.1. *Rethinking Ostrom's critique of privatization*

To argue that privatization and centralized state regulation are not the only solutions to the tragedy of the commons, Ostrom used as example 5 carefully selected case studies of what she referred to as successfully governed CPRs – the forests and meadows of Switzerland, the ancient villages of Japan, the ancient huerta irrigations of Spain and the zanjera irrigation of the Philippines.

Interestingly, all of these 5 cases are privately owned resource systems and not CPRs following the conventional definition of excludability as the defining attribute of private property. These resources – the meadows and forests in Switzerland and Japan and the ancient irrigation systems in the Philippines and Spain – all stationary resources – are not strictly CPRs in which exclusion is difficult but are in fact some form of limited access, private property rights in which exclusion to the resource system is highly feasible. Table 1 summarizes the results of this reassessment of evidence from Ostrom's (1990) work.

First, there are clear eligibility requirements to access the resource and exclusion is feasible because of the feasibility of monitoring and enforcement. Second, in the case of irrigation examples, both the resource systems and the resource units have been unitized, quantified and were tradable and hence excludable. By definition, these can be considered as private property rights. Third, these commons were collectively owned by groups (or limited partnerships) – village councils, cantons, partnerships, corporations, cooperatives, associations – implying some exclusion and eligibility requirements and thus making them privatized commons. That they were successful as defined by Ostrom should not come as a surprise – privatization of stationary commons has resolved the problem of tragedy as predicted by the standard model of the commons.

In contrast, and this is an important point, most of the cases Ostrom found as institutional failures were all cases of

	Excludability	Non-excludable
Rivalrous	Private goods	Common pool resources
Non-rivalrous	Club goods	Public goods

Fig. 4 – Typology of goods.
***Source*: Ostrom and Ostrom (1977).**

Table 1 – Reassessment/reinterpretation of the evidence from Ostrom's (1990) work.

Examples of commons studied by Ostrom (1990)	Feasibility of exclusion/clarity of property rights (based on author's reassessment/reinterpretation of Ostrom (1990))	Institutional/resource outcomes (based on Ostrom's assessment)
Meadows/forests of Torbel Switzerland	**Feasible** (access to commons defined by membership in local villages, corporations, cooperatives, cantons, associations which controls access) (see p. 61–65); in effect these are privately owned commons	**Robust**
Japanese mountain meadows	**Feasible**/access to the commons defined by village membership/small group size makes exclusion feasible (see p. 65–69)	**Robust**
Huerta irrigation in Spain	**Feasible**/water rights were fixed and unitized; monitoring is credible and enforcement of private rights feasible (see p. 69–81)	**Robust**
Zanjera irrigation in the Philippines	**Feasible** (rights to the resource system (canals) and units (water) were unitized, quantified and are tradable; water control structures made enforcement credible and therefore exclusion in feasible) (see p. 82–88)	**Robust**
Mojave ground water basin	**Exclusion is difficult** because rights are unclear/contested and system is very large (15 interconnected basins)/no water associations were formed (see p. 146–150)	**Failure**/conflict among water users/overdraft
(Raymond, West, Central basins) (earlier case)	**Exclusion is difficult** because rights were unclear and resource systems large (Raymund basin 277 square miles, West Basin 170) (see p. 11–132)	**Failure**/conflict among water users/overdraft
Nova Scotia, Canada offshore fisheries	**Exclusion is difficult** (fishing ground covers 440 square km; considered open access; rights of local fishers to police not recognize) (see p. 173–175)	**Fragile** institutions
Kirindi Oya irrigation, Sri Lanka	**Exclusion is difficult** (rights to irrigation unclear/no water control structures/ irrigation association weak to make enforcement credible) (see p. 157–172)	**Failure** of collective action
Alanya offshore fisheries, Turkey	**Exclusion is difficult** (unclear boundaries of resource and users; ineffective conflict resolution mechanisms) (see p. 18–21)	**Fragile**/conflict
Mawelle fisheries, Sri Lanka	**Exclusion is difficult** (for the number of nets that can be used and because ownership patterns constantly shifting while rights are not unitized, quantified and tradable) (see p. 149–156)	**Failure** (overfishing)
Bodrum inshore fisheries, Turkey	**Exclusion is difficult** (three mile limit rarely enforced; no clear boundaries of resource and fishers; no monitoring, sanctioning, conflict resolution mechanisms) (p. 144–145)	**Failure** (overfishing/rent dissipation/sharp drop in catch per unit of effort)
Bay of Izmir fisheries, Turkey	**Exclusion is difficult** (too many fishers (1800), large resource system, heterogeneous interests) (see p. 144–146)	**Failure** (overfishing)

CPRs – 2 cases of offshore fisheries from Turkey and one each from Sri Lanka and Nova Scotia; 2 cases of ground water and 2 cases of irrigation (see Table 1 above). These examples – all mobile resources – clearly qualify as commons: exclusion to these relatively vast offshore fishing grounds is difficult compared to the smaller irrigation systems, forests and meadows in the case of successful examples. Privatization of resource units (fish in this case) is also not feasible because of their mobility and the fact this is an offshore (open) fisheries. Because exclusion to the resource system and unit is difficult (though not impossible) and because consumption is rivalrous, not-surprisingly, the outcomes have been consistent with the standard model of the tragedy of the commons.

Similarly, in the case of the groundwater in the Mojave, California basin as well as ground water in the cases of Raymund, West and Central Basins in California, ground water rights were unclear or contested, the resource system relatively large and as a corollary, enforcement is non-existent. As a result, and not surprisingly because these are commons, their performance has been judged to be failure (i.e. overdraft) as predicted by the standard model of the tragedy of the commons.

6.2. *Evidence from fieldwork*

Following Ostrom's challenge to her graduate students and other scholars to revisit the case studies that she has studied, I went back to revisit in 2007 one such case of a successful example which was earlier documented by Siy (1980): the Bacarra-Vintar Zanjera irrigation in the Ilocos Province, the Philippines (Author's name withheld, 2013). From this fieldwork, it appears that the zanjera irrigation is not strictly a CPR (exclusion is difficult) but rather a resource that is privately owned by a cooperative irrigation society (the Zangjera). There are at least three pieces of evidence to support this.

First, in the zanjera irrigation, eligibility requirements are clear: to benefit from the irrigation system, farmers should have contributed certain amount of labor and materials toward land and irrigation development. Second, and this is crucial, exclusion is highly feasible in that only eligible members of the irrigation association are allocated land and water rights. These rights in turn are easily enforceable given the relatively small size of the irrigation system and the dense mechanisms of monitoring that are in place. For instance, water allocation is sequentially scheduled and because this is common knowledge, then every farmer has an incentive to monitor compliance of this water allocation. Third, and equally important, these land and water rights have been unitized, quantified and are tradable in the form of ATAR system of property rights – an indigenous way of allocating costs and benefits that is unique to the zanjera (see Araral (2013) for a description of the ATAR shares).

For these three reasons, the zanjera irrigation does not strictly qualify as a CPR (difficult exclusion) but rather took the form of a limited access/privatized resource (exclusion is feasible) and governed by a cooperative society. Forty years

after the zanjera was documented, it remained successful (in the sense defined by Ostrom) as predicted by standard model of the commons (i.e. privatization of the CPR is a robust solution to the tragedy of the commons).

6.3. *Institutional design principles as evidence of privatized commons*

There is one more final and important point in support of the argument that Ostrom's critique of the privatization of the commons needs a rethinking. Most of Ostrom's principles for institutional design – clear boundaries of the resource and resource users, effective and accountable monitoring, sanctioning and low cost conflict resolution mechanisms – when taken together actually makes exclusion to the common pool resource more effective. Not surprisingly, successfully managed, long-lived and robust commons are associated with these design principles.

Likewise and not surprisingly, common pool resources cited by Ostrom (offshore fisheries and groundwater) – which lacked these institutional design principles and therefore makes exclusion difficult – has led to outcomes predicted by the standard model of tragedy of the commons.

It might be argued that even if exclusion of the commons is feasible, there remain considerable collective action problems to be solved such as the problem of supply of institutions, credible commitment and the problem of mutual monitoring. The response to this argument is that in privatized commons such as meadows, and forests – where resource units can be unitized, quantified and traded – there will be an incentive for the holders of these rights to solve these institutional problems as predicted in the standard model of the commons. The model argues that as the value of the common pool resource increases, there will be a demand for institutions to protect them. Consequently, rights owners will try to find ways to supply institutions (through self-regulation, private policing or by demanding external protection) as well as find ways to monitor the enforcement of rules and resolve conflicts if they are to capture the value of the resource.

6.4. *Critique of the Leviathan*

Compared to Ostrom's critique of privatization, her critique on Leviathan (regulation of the commons by a central government) can be regarded as relatively more successful, both empirically and theoretically. The extensive theoretical literature on principal-agent problems, information asymmetry, rent-seeking behavior by bureaucrats, among others all point to the potential problems of centralized regulation of the commons. The empirical examples cited by Ostrom (1990) are themselves evidence of the ability of local resource users to solve collective action problems without the necessity for central government regulation. The work by Lam (1998) unambiguously showing that farmer managed irrigation systems perform better than government managed systems is a classic evidence also in support of Ostrom's critique of the Leviathan solution. There are of course critique of the potentials and limitations of decentralization in natural resource governance, for instance Andersson and Ostrom (2008) and Larson and Soto (2008).

7. Conclusion and implications

This paper is dedicated to a critical appreciation – or interrogation – of the legacies of Ostrom in environmental governance. Several conclusions can be inferred. First, Ostrom's critique of Hardin could perhaps be qualified as a special case of small, locally governed commons, Second, Hardin's tragedy of the commons seem justified in the case of large scale, national, regional and international commons. Third, studies that argue for the external validity of most of Ostrom's institutional design principles could be fundamentally flawed. More rigorous studies are needed to make them generalizable. Finally, Ostrom (1990) is justified for her critique of the Leviathan solution to the tragedy of commons but a rethinking is needed of her critique of private property rights and markets.

The last conclusion deserves a caveat because of another possibility, i.e. that perhaps Ostrom's (1990) criticism is not about private property rights per se – in which case I could be wrong in my interpretation – but rather what she feared as externally imposed privatization of local commons. Her legitimate concern is that the tragedy of the commons narrative would lead to policy prescriptions that result into externally imposed privatization of the commons, for example corporations being awarded concessions to local commons already de facto governed by local communities. This conjecture is highly plausible since Ostrom (1990) wrote her seminal book at a time when the debate on privatization and centralized regulation of the commons was at its peak.

Moreover, proponents of privatization of the commons at that time – the first generation literature – are also partly to blame. First, their very strong claim that privatization is the only way to solve the tragedy of the commons and that the tragedy is inexorable have not been empirically established. Second, they have not recognized the fact that privatization of CPRs need not be externally imposed or maintained by a Leviathan but could actually evolve from the ability of local communities for self-governance. Third, they have also contributed to conceptual misunderstanding because they have not provided a concrete definition by what they meant by privatization of the commons particularly for non-stationary resources such as water and fisheries as well as for global/regional commons.

From these preliminary conclusions, I argue that there is a case for a revisionist view of Ostrom and Hardin and to build on their legacies for a third generation research agenda on the commons. The first generation literature often proposed market and state governance solutions as the ''only way'' – the panaceas – to solve the tragedy of the commons. The second-generation research program – associated with Ostrom and her colleagues – argued for more nuanced, diagnostic, multi-disciplinary and empirical approach beyond panaceas.

I propose that the third generation research agenda on the commons move away from research that are basically variations of the same theme (which variables are important) and arrives at fundamentally the same and settled conclusion (i.e. the drama of local commons). I argue instead that scholars of the commons need to pay attention to the following fundamental questions raised in this paper.

First, is Ostrom's critique of Hardin really a special case applicable to small locally governed commons? Second, is Hardin really justified in the case of large scale, national, regional and international commons? Are there examples to the contrary? Third, how can the flaws in studies supporting the external validity of Ostrom's institutional design principles be remedied, for instance confirmatory bias, endogeneity, multi-collinearity and specification problems? Fourth, are the ''commons'' that scholars purport to study qualify as CPRs (i.e. exclusion to the resource system is difficult) or are they private property owned by limited partnerships? Fifth, are scholars who argue for the privatization of CPRs (organically evolved rather than imposed) justified in their claims that it can avert the tragedy of the commons? Or as a counterfactual, are there examples of privatized CPRs – overtime – that can be considered as unsuccessful contrary to the standard model? Until scholars of the commons unambiguously settle these questions, the conclusions from this paper should be considered tentative and merely points to unanswered questions and avenues for future research.

Finally, and most importantly, whatever limitations the first and second generation commons literature may have, future scholars of the commons certainly owe a debt of gratitude to Ostrom and her colleagues for having laid down the foundations for a third generation research agenda on the commons and inspiring a new generation of scholars.

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