Hardin versus Ostrom: Can Development Affect the Propensity to Cooperate over Environmental Commons?

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THE "TRAGEDY OF THE COMMONS" (HARDIN 1968 AND 1998; LLOYD 1833) IS a familiar concept to those concerned about environmental problems around the world. Climate change, pollution of air and water, declining fish populations, groundwater depletion, shrinking wetlands, deforestation, biodiversity loss, desertification, dust storms, and waste pollution are among the environmental tragedies that have been fully or substantially caused by the unsustainable use of environmental commons. The emergence and intensification of these environmental problems around the world provide ample evidence for the practical relevance of Garrett Hardin's cynical projection of what the commons' beneficiaries could expect in the long run if they continue to act based on individual rationality as opposed to group rationality. Yet Hardin's views, assumptions, and solutions have been seriously criticized by many scholars (Cox 1985; Dahlman 1991; Mildenberger 2019; Sharma 2017; Basurto and Ostrom 2009; Crowe 1969; Araral 2014; and Feeny et al. 1990).

Often, the critiques of Hardin's tragedy of the commons theory refer to real-world examples of cooperation among the beneficiaries of the common-pool resources (defined in economics as subtractable

and nonexcludable resources [Madani and Dinar 2013]) that have enabled them to avoid the problems of congestion and overuse. Most notably, the seminal findings of Elinor Ostrom on successful management of the commons, which earned her the Nobel Memorial Prize in Economic Sciences in 2009 (Ostrom 1990 and 2005; Ostrom, Schroeder, and Wynne 1993; Ostrom, Walker, and Gardner 1994; Hess and Ostrom 2007), are used to challenge Hardin's ideas. In her field research, Ostrom found that some communities around the world, including in Kenya, Nepal, Indonesia, Spain, Switzerland, Japan, and the US state of Maine, successfully escaped the social trap in managing the commons by developing cooperative institutional arrangements.

The discussions on whether Hardin or Ostrom is right about the commons have been going on for decades. But do the arguments of Garrett Hardin and Elinor Ostrom really reflect two opposing views regarding common-pool resources? In this paper, I argue that the observations and theories of Hardin and Ostrom are not mutually exclusive and do not necessarily contradict each other. Instead, I propose applying the Hardin and Ostrom schools of thought in a complementary manner to better capture and describe the state and evolution of the world's environmental commons through time as societies continue to grow economically. Based on the many examples of competition and cooperation over natural commons around the world, I insist on acknowledging the coexistence of noncooperative behavior based on self-interest (the Hardin school) and cooperative behavior based on group rationality (the Ostrom school). To justify this coexistence, I propose taking into account a new variable, i.e., *propensity to cooperate*, that is reflective of cooperation potential within a society and dependent on its level of development. Adding the level of development as a new dimension to the analysis of cooperative and noncooperative institutions for managing the environmental commons helps explain the potential for the emergence and successes of the Hardinian and Ostromian settings and their level of dominance through the course of development.

COMPLEX HUMAN-NATURE SYSTEMS

The environmental common-pool resource management problem belongs to the class of coupled human and natural systems (CHANS) problems. CHANS, also known as coupled human-environment systems and coupled social-ecological systems, are interconnected, dynamic, and complex systems in which humans and nature interact with one another, with feedback across social (human) and natural (environmental) systems (Turner et al. 2003; Walker et al. 2004; Carter et al. 2014; Ferraro, Sanchirico, and Smith 2018). CHANS problems involve causal relationships, nonlinear feedback, counterintuitive dynamics, paradoxical behavior, and unintended consequences (Liu et al. 2007; Madani and Shafiee-Jood 2020). When dealing with environmental common-pool resource management problems, one must note the following points:

1. *It might be easy to study the past, but projecting and enabling the future is very hard.* CHANS have some essential characteristics that make understanding their behavior and projecting their future very challenging. These characteristics include complexity, uncertainty, nonstationarity, indeterminate causality, limited predictability, evolutionary change, and bounded rationality (Hjorth and Bagheri 2006; Madani and Shafiee-Jood 2020). Our observations and ex-post analyses of the past behavior of these systems can lead us to some generic models for rationalizing the desirable and undesirable consequences of certain historical actions and governance structures, as done by Ostrom. Nonetheless, given the evolving nature of these systems (Madani 2010; Ristić and Madani 2019), our ability to project their future under various scenarios (involving human interventions and natural changes) will be very limited (Madani and Shafiee-Jood 2020). Likewise, designing intervention mechanisms and cooperative institutions that can lead

us to desirable outcomes in these systems could be very challenging, especially in large-scale problems (e.g., climate change).

2. *Ostrom's congenial observations do not reject the possibility of the emergence of Hardin's tragedy of unregulated commons.* While Ostrom's observations of some past successes can make us hopeful about the future of environmental commons and reject the idea that tragedy of the commons is their inevitable destiny, one cannot reject the possibility of the emergence of the situation described by Hardin based on such observations. The world already has many examples of congested and overused commons where the absence of collective action arrangements has led to declining gains for their beneficiaries. Regardless of the limitations of Hardin's analysis, these examples prove that the tragic situation he described is quite possible and, in some contexts, even quite likely.
3. *Neither Ostrom's desirable observations nor Hardin's undesirable expectations are stationary.* The evolving nature of human-environmental systems problems can turn cooperative situations into noncooperative ones (Madani and Lund 2012; Madani 2013; Ristić and Madani 2019) and vice versa. Systems that are benefitting from sustainable and cooperative governance institutions are still prone to the risk of failure under evolving conditions, abrupt changes, certain sequences of incidents, and extreme natural and social events (e.g., extreme drought leading to over-pumping of groundwater, or the election of Donald Trump as president of the United States and his decision to exit the Paris climate accord), depending on their level of resilience. Thus, the cooperative governance systems for sustainable management of natural commons described by Ostrom can fall into the

trap described by Hardin under certain projectable and non-projectable conditions. On the other hand, systems that have fallen into the social trap described by Hardin have the opportunity to escape such trap proactively or reactively (in response to certain events) using the cooperative institutions discovered by Ostrom.

4. *The solutions and guidelines suggested by Hardin and Ostrom are invaluable, but cannot resolve the commons problem, as complex CHANS problems essentially have no solutions.* The commons problem is not a complicated one to be solved through silver bullets, recipes, rules, algorithms, or natural laws. This problem is complex, with many unknowns, uncertainties, trade-offs, and interrelated variables (see Nason 2017 for more on the difference between complex and complicated problems). Complex problems are bigger than the sum of their parts and continuously evolve in an unpredictable manner. Complexity can be managed but cannot be removed. In other words, we can deal with complex problems but cannot solve them, as they do not have solutions. Failure cannot be fully avoided in the management of complex problems. But past observations, experience, foresight, and intuitions can help us better manage these problems, be prepared for their future evolutions, and build adaptive capacity to adjust actions in response to changing conditions based on the new lessons learned in a never-ending learning-by-doing process.

The goal of managing complexity is not to solve and end the problem in one shot, but to take a range of actions over time that minimize the likelihood of irreversible damages and losses. The invention of new technologies or the implementation of solutions proposed by Hardin and Ostrom, such as private property rights, top-down government interventions, or bottom-

up collective action arrangements can help manage the commons problems in certain conditions but cannot completely resolve them. If they could have done so, we would not have so many environmental commons problems around the world today. The guidelines and solutions provided by Hardin and Ostrom are not silver bullets, but they can certainly inform and facilitate the process of managing the commons. These solutions and guidelines are not mutually exclusive and can be implemented in a complementary manner. None of them is necessarily superior to the others. Their effectiveness can vary based on the conditions of the commons problem at hand, and their implementation does not always lead to the same outcome even in identical cases.

THE ROLE OF DEVELOPMENT

The complexity of natural commons governance problems makes them intractable. The rationality models we develop to simulate or justify the decision-making processes in the management of commons cannot fully capture real-world complexities, no matter whether they are based on individual or group rationality (Hardin vs. Ostrom). In reality, the decision-making agents (the beneficiaries and regulators of common-pool resources) do not all make decisions based on self-interest with no foresight into the future (Madani 2013). Nor do they all have perfect foresight and act based on group rationality. Tendencies to free-ride and compete coexist with motives to engage with communities in cooperating on the protection of a common-pool resource. Tendencies and actions of the users of commons change based on the range of heuristic strategies they develop (Madani and Dinar 2012) to make decisions regarding their interactions with other users. These evolving strategies are dependent on the changing state of the common as well as its users' changing demographic characteristics (Dasgupta 2001), beliefs, information, culture, and value systems

in the absence or presence of institutions, regulations, and technologies. While the overall behavior of a group of users can be observed and sometimes captured by our models (especially when modeling the past), detecting the heterogenous and evolving behavior profiles of individuals within a large common-pool resource users' community is, if not impossible, certainly not trivial (Pierce and Madani 2014).

The common-pool resource management problem is indeed a dynamic (evolving) multi-step problem (Madani 2010; Ristić and Madani 2019) in which the users' propensity to cooperate changes in response to variations in a range of socioeconomic and natural variables. Development, in my opinion, is a major variable that has impact on the propensity to cooperate on managing and exploiting environmental commons (figure 1).

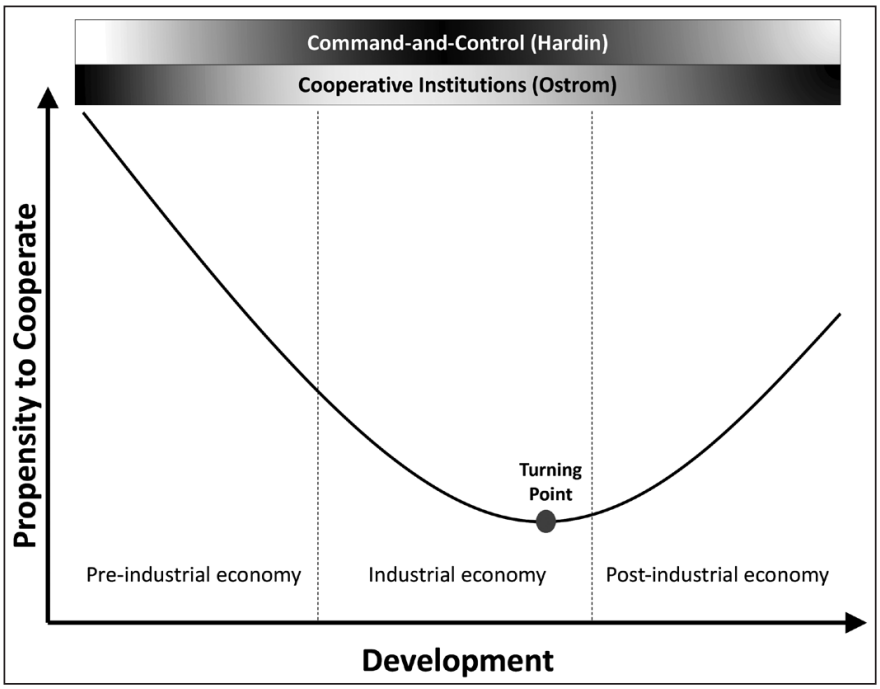

Figure 1. The proposed relationship between *development* and *propensity to cooperate* over the commons (DPC curve). The strength of the shades in the top boxes reflects the application intensity of the Hardinian and Ostromian regulatory and institutional arrangements to deal with commons problems. Graph by author.

In the early stages of development, the propensity to cooperate in society is very high. In underdeveloped agrarian societies, cooperation is essential for survival. The close relations and interactions of individuals within smaller communities minimize the chance for free-riding and acting based on pure self-interest. Any deceiving action could be sanctioned by a range of counteractions by peers in the community. Research by Ostrom and the history of traditional management of natural resources in old civilizations provide strong evidence that nomadic groups and rural communities have successfully developed cooperative institutions to sustainably manage their commons. The management institutions developed by the Persians to manage their groundwater extraction systems, known as *qanats* (English 1968; Wulff 1968) is a good example of collective action arrangements that supported life in the water-scarce Middle East for thousands of years (Madani 2014).

The process of economic development and the introduction of new technologies that increase the societies' capacity to expand the number of common-pool resource users and exhaust more resources constitute a threat to cooperative institutions that had been designed for a different (underdeveloped) state of human-nature systems. Many traditional cooperative institutions broke apart through the process of modernization and with the intrusion of new technologies. Increased development provided the capacity to survive while operating less cooperatively, expanded the size of user communities and resource exhaustion capacities, and affected cultures, beliefs, and socioeconomic norms. Economic development was accompanied by population increase, urbanization, and migration, imposing additional pressure on traditional institutions. As a result, systems that were unable to adapt collapsed and were replaced by noncooperative, competitive systems in which individuals had a lower sense of belonging to the community and no longer felt the need to cooperate with their peers for survival. The introduction of groundwater pumps in Iran during its agricultural modernization stage was a major reason for the failure of qanats and their associated cooperative management systems (Madani 2008).

Further economic development and industrialization promote demographic transitions. Formation of stronger, larger, and central governments together with migrations to cities and urbanization weaken traditional, smaller, local/rural governments. Consequently, economic development and industrialization in many parts of the world resulted in a decline in the propensity to cooperate over natural commons. Additionally, the increased demand for natural resources, together with the improved capacity to exploit them, made them more congested and harder to regulate and manage.

The continuation of economic development is accompanied by social and cultural developments to adapt to new socioeconomic and natural environments. Once the negative impacts of unrestricted exploitation of natural resources are observed, societal demand and government desire for stricter environmental regulations increase. Interventions that are initially imposed by the central government in response to increasing environmental degradation are mostly of the *command-and-control* type, in line with Hardin's school of thought. These interventions might help reduce the natural-resource dependence of political economy and natural-resource intensity of economic development, limiting subsequent damages to the environmental commons. However, they cannot drastically change the propensity of a sufficient number of users to cooperate in competitive environments where users suffer from economic and social inequalities.

At a certain point in the development process, reaching a sufficient level of average income is expected, at which point the majority of the population is no longer concerned with satisfying their basic needs. Urbanization and migration to cities slow, and the rural-urban inequality gap shrinks, both outcomes of the industrialization-democratization process and the rise of the welfare state (Galbraith 2007). This process can be accompanied by giving more authority and power to local governments and communities to participate in decisionmaking, regulation, management, and oversight. Increased transparency, reduced inequality, and social development (e.g., increased awareness about the value of a tax system and sustainable development), together with increased opportunities to participate

in decisionmaking, give a boost to the propensity to cooperate over the natural commons. In the post-industrialization period, making collective-action arrangements is facilitated by the political system, socioeconomic conditions, and state of technology.

The trajectory shown in figure 1 portrays a hypothetical relationship between development and propensity to cooperate over natural commons. In the early stages of development, the Ostromian institutions have a strong dominance. Cooperation is necessary for the survival of communities, and social institutions are formed to penalize deceptive behavior and noncooperative members of the society. As development continues and societies are industrialized, their members' propensity to cooperate drops due to major demographic, socioeconomic, and technologic transitions that abolish the traditional cooperative social structures and common-pool resource governance mechanisms. This weakens the Ostromian institutions and leads to the emergence of Hardinian noncooperative settings. Economic development and the increased resource exhaustion capacity also lead to the congestion of the commons and increased inequalities (Grossman and Krueger 1991; Dinda 2004; Madani 2020). At this stage, Hardinian top-down interventions are implemented by central governments (in the absence of strong local governments), but the adopted command-and-control mechanisms are not capable of stopping the environmental degradation process, especially in large systems. As long as the society is suffering from major economic inequalities, the propensity to cooperate continues to decline and Hardinian institutions prevail. Further socioeconomic development that secures a certain level of income for the society, satisfies its basic needs, and facilitates democratization can create a turning point in the development-propensity to cooperate (DPC) curve. After this point, development can increase the propensity to cooperate over natural commons. At this stage, small and local (bottom-up) governments are empowered, and gradually the Ostromian institutions outweigh the Hardinian institutions. Nevertheless, these institutions continue to coexist in a post-industrialized society.

WILL ALL SOCIETIES FOLLOW THE DPC CURVE?

The DPC curve shows a hypothetical relationship between development and propensity to cooperate over the commons based on what we have generally observed around the world. But nations and societies experience unique sequences of events and sets of changes along their development paths. They also have the opportunity of learning from each other, not repeating the mistakes of others, and bypassing the undesirable stages of development. So they do not all behave exactly like the DPC curve.

There is plenty of evidence that the development process has destroyed many traditional cooperative institutions. Nonetheless, certain societies (in both the developing and developed parts of the world) have been able to preserve or adapt their traditional cooperative systems in their development process, which has helped them avoid the social trap and commons dilemma. Communities also have the chance of proactively setting up cooperative institutions, and bypassing social traps and major decline in levels of the propensity to cooperate in the society (lowest points of the DPC curve). Yet many societies will not reach, much less pass, the turning point of the DPC curve in a reasonable future time frame. In nondemocratic societies and untransparent systems, where local communities are weak, the required social capital and trust for building bottom-up governance mechanisms and promoting cooperation are lacking. These systems will continue to see major environmental degradation and the failure of Hardinian command-and-control mechanisms employed by the central governments to protect the natural commons and secure sustainable development.

CONCLUDING REMARKS

The tragedy of the commons is not a myth, but neither is it an inevitable destiny. As Elinor Ostrom has shown us, the beneficiaries of natural commons in some parts of the world have been able to develop effective cooperative arrangements to escape the social trap and address the commons dilemma. Yet her evidence does not fully

reject the possibility of the tragedy of the unregulated commons in a complex and changing world. Garrett Hardin's analysis might be missing some elements of the truth and realities of human-nature systems, but with so many major environmental problems around the world, dismissing his cynical projections and suggested solutions is not reasonable.

The environmental common-pool resource management problem is a complex, dynamic (evolving), multi-step, and never-ending problem in which both cooperative and noncooperative tendencies exist. Thus, the arguments and observations of Ostrom and Hardin are not necessarily mutually exclusive and contradictory. Acknowledging the coexistence and complementarity of Hardin's undesirable expectations and Ostrom's desirable observations in different stages of development, as proposed in this paper, helps us better navigate through complex natural commons problems and manage (not solve) them and design more practical solutions. This can be facilitated by using the proposed DPC curve that determines the level of dominance and potential success of the Hardinian and Ostromian institutions based on societies' level of development, which affects their propensity to cooperate.

Environmental commons that are currently managed sustainably under collective action arrangements risk the emergence of the tragedy of the commons if such arrangements lack sufficient adaptive capacity to adjust to the changing socioeconomic and natural conditions, especially if the changes are large and abrupt. On the other hand, commons that are suffering from beneficiaries' actions based on self-interest have the chance to develop cooperative arrangements and escape Hardin's projected trap. While the DPC curve makes us hopeful for the possibility of promoting and strengthening cooperative institutions in later stages of development, we must not forget that many human societies might not reach the post-industrialization stage in the near future. Systems that fail to become democratic and remove economic inequalities through the economic development and industrialization process cannot pave the way for the reintroduc-

tion of cooperative institutions to sustainably manage their natural commons.

Scale is another issue that must not be overlooked in analyzing natural common-pool resource problems. The size and conditions of a shared resource, the number of its users, and the heterogeneity in their socioeconomic conditions, level of access to the resource, and capacity to negatively or positively impact it change the complexity level of a natural commons problem. Obviously, larger and more complex problems are harder to manage. Success in setting up cooperative institutions for managing smaller natural commons problems (e.g., at the village or city scale) does not make successful implementation of large-scale cooperative systems (e.g., at the national, regional, and global scale) a straightforward and trivial process. Dealing with large-scale problems such as climate change requires major efforts and must benefit from a portfolio approach that implements a mix of top-down and bottom-up institutions based on the guidelines and observations of both Garrett Hardin and Elinor Ostrom, with careful attention to the levels of inequalities and the development stages of the involved societies.

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