

The Tragedy of the Commons: Institutions and Fisheries Management at the Local and EU Levels

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ABSTRACT *Garrett Hardin's Tragedy of the Commons argument states that resources held in common will inevitably suffer overexploitation and degradation. However, recent contradicting evidence has led theorists to question the soundness of this claim. This paper assesses the accuracy and predictive success of the six essential assumptions of Hardin's approach. The aim of the paper is to compare the functioning of the tragedy of the commons approach at the local and the international levels, in order to demonstrate that the context we choose affects the applicability of the hypothesis in explaining policy outcomes. The paper compares the validity of the tragedy of the commons hypothesis in three marine cases: California fisheries, modern Oregon fisheries and European Union Common Fisheries Policy. We find that at the local level the tragedy of the commons can be mitigated when a co-management of institutions is achieved, while the EU case shows that the tragedy of the commons is a realistic prediction when dealing with international institutions.*

1. Introduction

In recent years there has been a lot of discussion of Garrett Hardin's 'tragedy of the commons' approach to resource management (Hardin, 1968; argument also evident in Hardin & Baden, 1977). Theorists have begun to question the soundness of Hardin's claim that common ownership of resources leads to the overexploitation, mismanagement and eventual degradation of those resources. Hardin proposes two solutions to this problem: the transfer of resources either to private hands or to government control. The empirical record, however, is unclear regarding the link between overexploitation and common property. Although overexploitation has occurred, its incidence is not exclusive to situations of communal property or open access as suggested in the tragedy of the commons (TOC) argument; overexploitation has also occurred under private- as well as state-property regimes. Similarly, successful resource management is seen in the context of a

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merger of communal, private, and state property regimes. Obviously, the TOC argument is an oversimplification, and an alternative approach, which provides co-management at the local level through a merger solution, is more appropriate (Feeny *et al.*, 1990, pp. 1–2).

This paper examines the essential assumptions of Hardin's TOC approach both for their accuracy and predictability, and tries to establish when the TOC method can be helpful in explaining a policy outcome. The TOC has proved to be a very important concept in international political economics, since it determines when states, institutions or individuals will cooperate to conserve the common good and to lessen the transaction costs of negotiation and enforcement. The aim of this paper is to compare the TOC approach at the local and the international levels, in order to demonstrate that the context affects the applicability of this method in explaining policy outcomes. The focus will be on marine resources, using three case studies: the history of California fisheries, modern Oregon fisheries and European Union Common Fisheries Policy (EU CFP). The California and Oregon cases will demonstrate that the TOC can be mitigated if a co-management of local institutions is achieved, while the EU CFP case shows that TOC is a realistic approach when dealing with international institutions.

2. Definitions and Concepts

Before analyzing the case studies and arguments, a number of terms and concepts should be defined and explained. First, unlike public goods that are inexcludable and inexhaustible, the term common-property resource refers to 'a class of resources for which exclusion is difficult and joint use involves subtractability' (Feeny *et al.*, 1990, pp. 1–2). Most marine resources fit this definition. Demarcating boundaries and excluding potential users of the resource are obvious problems in the context of migratory species. However, for sedentary species (like oysters) these issues are less problematic. In addition, it is well documented in fisheries literature that the catch taken by one fisherman affects the productivity of other fishermen, as well as the future productivity of all fishermen since it affects the stock of fish. Thus, 'subtractability' or rivalry is a salient characteristic of most marine resources (Feeny *et al.*, 1990, pp. 1–2).

Second, it is important to define the different types of property-rights regimes in which marine resources are held. There are four basic ideal types: open access, private property, common property and state property. Open access is the absence of a property right, where the resource is open to all people. Until recently, most marine resources beyond 3-, 12- or 200-mile coastal zones fell into this category. Under private property, the right to the resource is held by an individual who manages the resource as he or she wishes. Generally 'aquaculture and marine-culture' fall into this category. Not only does private property include individual rights, but also partnership and corporation rights. Under communal property, the rights to the resource are assigned to an identified group of users who manage the resource and who may exclude others from harvesting the resource. This type of property-right regime was common among traditional artisan fishing communities and is found in a number of modern coastal fisheries throughout the world, including Atlantic Canada and Japan (Demsetz, 1967). Finally, under state property, the

government regulates access to and utilization of the resource. Currently, this regime is found within the 'coastal economic zones' of states. These are ideal categories: in reality, resources are often held in a combination of the above regimes.

It is important to distinguish between *de jure* and *de facto* regimes. *De jure* fisheries within the 200-mile limit are state property. In practice, however, many fisheries within that boundary are *de facto* open access to the citizens of that state. The state has the authority to regulate access to the fishery. In some cases the state officially regulates access, but does not enforce it. In other cases the state does not restrict access among its citizens. In both cases open access is likely to be the outcome (Feeny *et al.*, 1990).

Evidence from case studies will be used to examine six important and sometimes overlapping categories of assumptions that underlie Hardin's TOC approach: individual motivations, characteristics of individuals, the nature of existing institutional arrangements, interaction among users of the resource, the ability of the users to create new institutional arrangements, and the behavior of regulatory authorities.

It is important to describe Hardin's assumptions for each of the six categories presented above. In the TOC model, fishermen are assumed to act as if they were profit-maximizing firms. They are also seen as generally homogeneous and lacking distinguishing characteristics. Hardin's model assumes that access to the fishery is open to all. Individuals are assumed to have no direct contact or interaction with each other. Furthermore, individuals are assumed to be powerless to alter institutional arrangements or to affect the outcome of those arrangements. Finally, the TOC model contains no explicit account of how the regulatory authorities act.

Hence, in this setting, each fisherman will take into account only his own costs and benefits, and ignore the fact that increases in his catch affect the returns to fishing efforts for other fishermen as well as the health of future fish stocks. Hardin's assumption of open access provides free entry until economical and ecological over-fishing is reached as a result. This conclusion accurately describes many real-world outcomes, but it ignores other important behavioral motivations and situations and provides an incomplete and misleading model through which to understand fishermen or to formulate fisheries policy.

The accuracy of the assumption of Hardin's TOC model will be explored in the next section. A general inference from case studies will be assembled and, in particular, from evidence from two case studies, California vs. Oregon at the local level, and EU common Fisheries policy at the international level.

3. The Six Assumptions of the TOC Model

3.1. Individual Motivation

One way to characterize Hardin's approach is that individuals are assumed to act 'myopically', oriented only toward short-term gains. This conclusion is the result of the assumption of profit maximization, open access and the 'rule of capture' (i.e., the fact that property rights in the fishery are not assigned until somebody catches the fish). All these assumptions imply that it is rational to ignore how

individual actions affect others and the future. In such environments people act as if their motivation is short-term gain, even if this is not their true motivation or 'objective function' (Hardin, 1968).

The attitudes of Oregon trawl fishermen support Hardin's TOC assumption of profit maximization. It is clear that Oregon fishermen are not fishing for sport; they make large investment in vessels and gear, and they fish to earn money. Financial return is a major reward for them. However, profit carries a far broader meaning to them because financial reward includes not only the amount of income but also the opportunity to run a family business and to make a living. Also, Oregon fishermen have non-pecuniary goals such as adventure, prestige, and the independence (being one's own boss) that fishing provides. Preference for non-pecuniary goals has important implications; individuals with such preference are willing to sacrifice some pecuniary rewards in order to consume more non-pecuniary ones (Hanna & Smith, 1993, pp. 368–369).

Altruistic motives may also be present. Many studies indicate that free-riding is typically less than complete, even in situations involving repeated play in which subjects have had the opportunity to assess the costs and benefits of free-riding. In the context of fisheries, if fishermen cooperate to restrict their catch to ensure sustainability they will all benefit. The fisherman who does not, thereby allowing others to bear the cost of restraint while continuing to harvest at the usual rate, is a free-rider. Cultural norms, ideology and value systems appear to affect the degree of free-riding.

The evidence from these studies must be interpreted carefully. Complete free-riding appears to be uncommon as does the complete absence of free-riding. Social norms matter, but, in the absence of an enforcement mechanism, are unlikely to be sufficient to eliminate or control free-riding. Thus, although an assumption of self-interested behavior is important for meaningful analysis, it is not completely correct and can be misleading. It is clear, however, that when individuals are operating in environments such as the one presumed by TOC, they are aware of the effects of their current actions on others and on the nature of fisheries management. Individuals report that they would like to see the fishery managed to provide a sustainable livelihood (Hanna & Smith, 1993, pp. 373–374).

3.2. Individual Characteristics

In Hardin's approach, individuals are assumed to be identical; firms are homogeneous and therefore interchangeable. This assumption greatly simplifies the analysis and was an important part of his original demonstration of the incentives for economic overexploitation in situations involving open access and therefore free entry.

Throughout the history of California fisheries, both their ecological and social ecological systems have been highly complex. The region's biology is extraordinarily diverse, involving interactions between fish stocks, between stocks and harvesting, and between stocks and their environment. The region's social ecology was complex, as well. Amerindians, Chinese, Portuguese, Japanese, Italians, Anglo-Americans and other groups have all fished in California at one

time or another, each with its own particular target species, its own technologies, and its own methods of informal control over access to the harvest and allocation of its proceeds (McEvoy, 1988, pp. 211–213).

Oregon trawl vessel captains are both homogeneous and heterogeneous in their characteristics. Captains are alike in their ownership of vessels, family association with fishing, and lack of strong ethnic identification. Most captains are owner-operators who have strong family associations with fishing. They tend to have more fishing experience and less formal education. Most captains fish out of a single port and sell their fish to a single processor. Vessel captains differ widely in their years of fishing experience, level of formal education, age of vessels, and fishing patterns. There are also the specialists who focus on fewer species and usually have more variable incomes than generalists, who diversify landings over several species (Hanna & Smith, 1993, p. 370).

As a description of the nature of individuals and firms involved in fishing, then the assumption of homogeneity is often inaccurate and sometimes misleading. As the Oregon and California cases demonstrate, there are considerable differences among individuals and firms in terms of the size and scope of their operations, their abilities, education and experience, the degree of their lifetime commitment to the industry, their preferences over non-pecuniary aspects of their employment, and the technologies they employ. This heterogeneity has important implications for political economic analysis and the effects of regulation on the fishery (Hanna & Smith, 1993, pp. 373–374).

3.3. Nature of Existing Institutional Arrangements

Hardin's analysis assumes either open access or state property, with free entry and free exit. The assumption of the lack of property rights, formal or informal, was crucial for obtaining clear predictions concerning outcomes (eventual overexploitation of the resource). Because the TOC approach focuses on only two property regimes, it has little to say on other commonly found institutional environments (Feeny *et al.*, 1990, pp. 4–5).

Before the modern era of powerful governments, many fisheries were subjected to both formal and informal property-rights systems and regulations. Traditional hunting groups defined and enforced exclusive harvesting zones. In addition, customs and norms served to regulate use and limited exploitation to levels that could be sustained. Historically, most market fisheries in 19th century California operated under informal regulatory regimes maintained and enforced through the power of the ethnic producers' coalitions. Fishermen of particular ethnicity would lay claim to familiar stock, exclude fishermen of other backgrounds, and then regulate the harvest and sale of fish through marketing cooperatives (McEvoy, 1988, p. 214).

Although access to the Oregon ground-fish fishery has, until 1994, been technically open to anyone with a commercial fishing license, access has in effect been limited by the nature of regulations. Trip limits, which constrain both the size of the catch per trip and frequency of trips for certain species, have been a primary management tool. For some species, the trip limits have confined fishing efforts to

small boats that can cover fishing costs within the imposed constraints (Hanna & Smith, 1993, p. 371).

So we see that in the case study of local fisheries, free entry is not an accurate description, nor is free exit. Informal and formal communal property rights systems as well as private and state property serve to limit entry into the fishery. Exit is limited because in many cases fishermen have invested heavily in industry-specific human and physical capital that is not readily transferred to other industries. Restrictive regulations for most current fisheries limit the viability of 'fish and run' resource mining strategies (Feeny, 1992, p. 269).

The TOC approach argues that the free-rider problem is so severe that fishermen will be unable to organize effectively to coordinate strategies or provide enforcement mechanisms. It is assumed that agents ignore the actions of others in formulating their own strategies. But fishermen are able to communicate with each other and devise cooperative strategies. The access limitation proposal initiated by Oregon trawl fishermen that eventually became regulation is one of many counterexamples to the TOC claim. A number of such cooperative approaches have been initially organized around restricting the daily catch so as to avoid saturation of the fresh fish market. Conservation is a by-product of these marketing strategies. Thus, although the transaction costs of coordination are substantial, they can be overcome in at least some circumstances and these circumstances are not rare (Feeny, 1992, p. 290).

Similarly, a number of informal and formal enforcement mechanisms have been observed. For instance, in the Maine lobster fishery, violations of informal private property rights to harvesting sites are met with gear destruction. More severe social sanctions and violence follow when milder sanctions are insufficient to enforce property rights and harvesting regulations (Acheson, 2003; Barry, 1998).

3.4. Interactions among Resource Users

The metaphor used to summarize the TOC argument is the single-period prisoners' dilemma game. In the prisoners' dilemma game, default is the dominant strategy and thus overexploitation is the prediction, even though both agents would be better off cooperating (Payne, 2000, pp. 319–321). Although Hardin (1968, p. 1246) directly appeals to this argument, it is 'free entry in a situation in which there is a negative externality that provides the mechanism for overexploitation in the [TOC] approach.'

But the single-period prisoners' dilemma game is of limited relevance to the TOC approach. First, real-world problems usually involve multi-period phenomena. Second, in natural settings, unlike in the prisoners' dilemma game, the players are able to communicate with each other. Thus, the game is played more than once by participants who can communicate, allowing viable cooperative strategies. In an infinite-period game, cooperation is a rational strategy. In a finite-horizon game, however, there is an incentive to default on the next to the last play. Players with rational expectations will realize this, and analytically the game will collapse to a single-period game with default as the dominant strategy (Berkes, 1985).

Despite this logic, there are viable strategies that promote cooperation. Tit-for-tat has proven to be an effective strategy in which a player cooperates unless another player defaults. In the event of default, the player defaults on the next round of play to punish the original defaulter, and then resumes cooperative play. Tit-for-tat reinforces the incentives to cooperate. The multiple-period context of many common-property resource management situations provides scope for learning the rules of new institutional arrangements, which converts the risks of single-period prisoners' dilemma game prediction that default will be the dominant strategy into one in which cooperation is a viable approach. The prisoners' dilemma metaphor overlooks the ability of agents to alter the rules to produce more desirable outcomes. Another problem with the metaphor is that in a prisoners' dilemma game the same players are involved in each round of play. However, in the dynamics of this case study, which allows free entry, there are new players at the table in each round until resources are over-exploited (Berkes, 1985, pp. 204–205).

In contrast to the assumptions of the TOC model, Oregon vessel captains routinely interacted with one another and were well aware of the collective impact of the individual actions of fleet members. Captains saw the existence of too many boats, over-fishing, and dwindling resource availability as important and connected risks to resource sustainability. The majority viewed the number of people fishing as a problem. The awareness of such collective issues as a factor creating risks in fishing is related to levels of formal education. As education level rises, assessment of collective effect also rises. The majority of vessel captains expressed support for a cooperative approach to fishery management (Hanna & Smith, 1993, p. 372).

3.5. Ability to Create New Institutional Arrangements

In the TOC approach, resource users are powerless to create new arrangements to prevent the demise of the resource. The costs of creating and operating new institutions are indeed substantial. The creation of a new institution itself is a form of collective action and thus is subject to free-rider problems. Similarly, there are free-rider problems associated with the operation of collective arrangements to manage the resource (Berkes, 1985, p. 204).

Nonetheless agents are sometimes able to alter the set of institutional arrangements to create new forms that better address their resource management problems. A number of investigators have described management schemes that have been put forth by inshore fishermen. In Oregon, input from fishermen affects regulatory policy. Oregon trawl vessel captains were important contributors to the plan developed to rationalize the fishery through a limitation on entry. A majority of the surveyed captains were sympathetic to the need to access limitation, recognizing the fundamental inconsistency of a finite resource exploited by an unlimited number of users. The trawl fleet initiated the rationalization process by advancing a license limitation proposal in 1988. The trawl proposal led to the development of a more comprehensive multi-year plan that was implemented in 1994. Oregon vessel captains listed poor communication between themselves, managers and biologists as an important hindrance to the

creation of new institutional arrangements. Captains saw greater cooperation between fishermen, managers and processors as essential to the design of regulations that are compatible with both the biological and economic components of the fishery (Hanna & Smith, 1993, p. 373).¹

3.6. *Behavior of Regulatory Authorities*

There is no explicit model of regulation in the TOC model. The model evaluates the effects of policy in terms of the impact on net social benefits. Actual policy outcomes are compared to a benchmark of what ideally could be achieved—the maximization of net social benefits. The existing institutional arrangement is compared to an abstract ideal and, not surprisingly, found to be inferior (Hardin, 1968, p. 1246).

There is, however, an implicit supposition in Hardin's approach that the regulatory authorities broadly act in the social and public interest. It also assumes that government scientists have adequate knowledge and data about the ecological system. The demise of the California fishery undermines both of these assumptions about the behavior of the regulatory authorities (McEvoy, 1988, p. 221).

Fisheries were among the first natural resources to draw organized government attention in the late 19th century because intensive harvesting and pollution had a profound effect on them. In California, the sardine fishery was destroyed by the interaction between harvesting and ecological changes. Also contributing to the collapse of the California fisheries was the fact that government itself was not the monolithic, perfectly efficient 'lawmaking machine' that was needed. Various government bodies competed with each other for political resources, and government scientists did not push the lawmakers to take the right decision, due to fear of losing the 'political capital' they had built with the industry. The ruin of the California sardine fishery, one of the worst wildlife management failures in US history, came about because of a tragedy of the commons, not only in the fishery itself but also in the legal and political processes that were supposed to counteract overexploitation. Too many government bodies competed for political resources for any of them to account meaningfully for this particular ecological problem (McEvoy, 1988, pp. 224–226).²

¹An important factor that affects institutional innovation by resource users is the nature of the political system. Long-standing communal property rights without formal recognition have often been insufficient to prevent incursions, as in the case of the demise of informal ethnic management of the California fisheries (McEvoy, 1988, p. 220).

²The idea was that scientists would find a solution to produce a 'sustainable yield' and the lawmakers would limit the harvest accordingly. The problem occurred because federal scientists made their calculations with the focus on species at the top of the food chain (i.e. seals); while neglecting other species (i.e. sardines) that are more sensitive to ecological changes. In this case, algebraic rather than a stochastic (probabilistic) calculations were used, which proved problematic later as the ecological environment changed. Added to that, lawmakers who did not want to disturb the industry based on new scientific predictions of a possible futuristic catastrophe maintained a status quo harvest limit, which eventually led to a depletion in sardine stock.

Yet it is possible for fishermen to participate effectively in the political process. In Oregon, many vessel captains questioned whether managers were acting in the best interest of the resource. The Oregon captains surveyed by Hanna & Smith (1993) were well informed about ecological relationships and long-term effects of short-term, and many of them serve on advisory committees and have given testimony at meetings of the Pacific Fishery Management Council.

Hardin's TOC approach predicts the overexploitation of common-property resources. The policy prescription generally inferred from the 'standard approach' is the transfer of the resource to private-property or state-property regimes. The policy discussion stresses market success and government structure. In contrast, the emerging alternative approach discussed by Feeny *et al.* (1996) is more flexible. The requirement here is that co-management at the local level involves the merger solution. In other words, this approach recognizes the potential viability of communal, private, and state property merger style. It also recognizes the potential for overlapping systems of property rights and systems of co-management. It recognizes that private property does not guarantee success and that, in addition to government success, there is government failure (Feeny *et al.*, 1990, pp. 18–19).

4. Explaining the Failure of the EU Common Fisheries Policy

This section discusses fisheries policy at the international level, in particular the EU common fisheries policy (CFP), in order to demonstrate the difference between local collective action problems—which we discussed earlier—and global collective action problems.

The general assumption is that there is a great deal of similarity among problems that actors face locally and internationally. Thus, the similarity between local collective action problems and international collective action problems is so strong that we can learn a lot by looking at them from a common framework. However, we may infer simply by looking at the difference in scale between local and international regimes that the similarity assumption is unrealistic. In local domains, the scale of the problem is much smaller and the number of actors is significantly restricted. Conversely, in international domains, the scale of the problem is much bigger and the number of actors is huge, thereby making the system a lot more complicated (Keohane & Ostrom, 1994).

The TOC occurs at the international level of the EU when dealing with common fisheries policy. A United Nation Food and Agriculture Organization (FAO) report indicates that 60% of the world's fishery stock 'has either reached a plateau, or are in decline.' However, the continuing problem of 'over-capacity of the global fishing fleet' indicates that pressure on these stocks is unlikely to decrease in the near future (Payne, 2000, pp. 303–304). The problem is even worse for fishery stocks that cross national boundaries, as they get exploited by many states and hence they are nearly depleted. The EU seemed to have the potential to overcome the TOC of international fisheries, and to allow its member states to attain sustainable management of their fisheries. This is because EU-binding rules on its members should have mitigated TOC problems of 'uncertainties over other resource user's actions, and difficulties in adhering to bargains'

(Payne, 2000, p. 304). However, the Common Fishery Policy, in effect since 1957, proved a failure at fisheries conservation. According to the FAO (Payne, 2000, p. 304), nine important community managed stocks are over-exploited and near depletion. This EU conservation policy failure is due to the nested institutional context in which the CFP is negotiated (Payne, 2000). In the EU case, we are dealing with a three-level game. At the first international level, member states negotiate complicated policies among each other; at the second national level, member states negotiate particular issues within their own polities at relevant government fisheries institutions; and at the third sub-national level, the domestic players (industries and fisheries lobby groups) negotiate and try to influence a policy within their respective member states and at the EU level. In this type of game the context is called a nested one because 'a particular policy is likely to have effects beyond the issue-area' (Payne, 2000, p. 309).

The principles chosen by the member states to guide the CFP seem to be politically practical, but ineffective at fish stock conservation. Nevertheless, these rules have been retained due to the political infeasibility of policy alternatives (Payne, 2000, p. 321). The TOC is a realistic concern when dealing with a three-level game (as in the EU), due to the huge scale and complexity of issues. Fisheries policies are relatively complicated because both the economic and the state actors enforcing the policies are decentralized, which makes monitoring compliance extremely difficult. The risk of defection and free-riding is therefore much higher. The perception that the other states will not comply exacerbates the problem. Hence, member states focus more on distribution (how to divide the pie) and less on efficiency (how to increase the pie) (Payne, 2000, p. 313).

We can conclude that, unlike in the case of local common property, the TOC is an effective framework in the case of international common property, where 'conflicts between member states' interests in fisheries and their wider interests in the competence of community institutions have contributed to the maintenance of ineffective policies' (Payne, 2000, p. 321).

5. Conclusion

The assumptions of the TOC approach with respect to individual motivation, individual characteristics, the nature of existing institutional arrangements, the interactions among users of the resource, the ability of users to create new institutional arrangements, and the behavior of regulatory authorities often appear to lack both descriptive accuracy and predictive power. However, the insights of the TOC approach should not be overlooked. In the absence of the ability to exclude others and in the presence of rivalry, economic outcomes are unlikely to be optimal. Individual self-interest is a powerful force and must be taken into account in the management of common-property resources.

Important limitations to the TOC are due not only to the inaccuracy of its main assumptions, but also to its limited perspective. It is often misleading to view the resource system through the lens of a single species. The study cases surveyed above show that the design of successful policies must take account of the numerous interactions of species within an ecosystem. Similarly, the preceding argument suggests that the main resource management issue is not the regulation

of utilization of a particular resource but balancing the interests of multiple uses and users. The context in which a fishery is exploited is more complicated than the simple one depicted in the TOC approach.

The TOC approach is a simple and powerful tool, with an important message. Of course the world is more complicated now than when the approach was first developed, and the model is an oversimplification; the same can be said for any model. The core of the argument presented here is not that every common-property resource management situation should be analyzed within a framework that takes account of all the issues omitted by the TOC; such a framework would be unwieldy. The point is that there is a host of evidence which suggests that local actors can solve local problems, as in California and Oregon fisheries; whereas grand international institutions like the EU make such local problem-solving extremely difficult. The qualification is that co-management at the local level involves the merger solution, which seems possible within a small setting. Conversely, at the international level, in principle, co-management can work but is more difficult to achieve, because it would also have to involve the merger solution, which is more complicated in a setting with multiple actors.

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