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Environmental Policy as an Institution of Collective Ownership: Water Pollution Control Policy in the United States, 1850-1980

Economic analysis of environmental policy has typically followed a few main approaches. Environmental economics has examined the performance of policy instruments in an ideal world of perfect competition and knowledge. It finds the economic instruments of environmental policy, such as effluent fees and tradable permits, attractive because of their efficiency and welfare implications. In contrast, the most common policy instruments, administrative “command and control” measures, receive unfavorable evaluations. One searches for an explanation for the observable popularity of prohibitions, performance standards, or effluent limits in environmental policy. The predominance of these allegedly inferior policy instruments is an anomaly for mainstream economics itself, which assumes rational, self-interested, perfectly informed, and maximizing actors throughout the economy and the polity. Those actors should have chosen the best policy alternatives, or else there must be something wrong with our understanding of how actors choose, how policy instruments work, or both.

The approach of law and economics, on the other hand, does not assume perfect knowledge and could study environmental policies more realistically as institutions that govern the use of environmental resources and that prevail in the world of positive transaction costs. However, many approaches to law and economics have been mainly interested in whether the transaction costs generated by institutional arrangements facilitate or hinder voluntary exchange. These approaches have often both averred from the study of and condemned complex statutory legal institutions, such as modern environmental policies. Behind their aversion has been the same narrow concern for economic efficiency and welfare that has characterized much of environmental economics and that has hampered the ability of both research traditions to examine the rationale, structure, functioning, and performance of actual environmental policies.

My paper argues that the contemporary research in common property opens up an interesting avenue for economic analysis of environmental policies. It facilitates the conceptualization of environmental policies as institutions for the ownership and management of environmental resources that may have been established, formulated, maintained, and/or changed in part to forward values other than economic efficiency and welfare. Research in common property also offers a structural model of institutions for ownership and resource management that enables a more detailed analysis of these complex institutional arrangements than environmental economics and law and economics have been able to accomplish. Law and economics can in turn offer tools to examine how the formulation of institutions affects their enforceability, consequences, and viability. In what follows, the first section of my paper discusses in greater detail how research in common property can be extended to the analysis of environmental policies.

The subsequent parts of my paper aim at demonstrating that research in common property can fruitfully inform the analysis of environmental policies by examining water pollution control policies in the United States from the middle of the 19th century until the environmental decade of the 1970s. The second section will examine how riparian law governed the polluting use of water-courses by early industrial establishments in the 19th century. I will discuss how, in part to facilitate economic growth and development, riparian law constituted a use of water as a transferable asset and established market allocation of water quality. The third section will examine how early water pollution control statutes enacted in many states after the turn of the century established collective ownership and political allocation of water resources to protect public health. The fourth section will discuss how federal water pollution control legislation responded to the larger scale and broader range of water pollution problems in the postwar era and protected the quality of water also for recreational purposes and for their own sake. I will also discuss in each section to what degree institutions succeeded in forwarding these objectives.

My conclusions summarize my observations on the structure, functioning, performance, and evolution of water pollution control policies in the United States. I will also indicate the implications of common property research for the analysis of environmental policies and vice versa.

1. Environmental Policies as Institutions of Ownership and Resource Management

Law and economics understands institutions as defining “the rules of the game” or as determining the rights and duties of individuals, their privileges, and their exposure to the exercise of rights by the others (North 1990; Schmid 1987, 1995). Private and common ownership are examples of institutions establishing rights and duties that both open up courses of action for economic actors and constrain choices available for them. Since environmental policies determine who may use environmental resources such as air or water basins and how, they could also be understood and analyzed as ownership arrangements. Depending on the case, they may be more or less akin to private or common ownership.

While law and economics can examine all kinds of institutional arrangements, it has paid more attention to private property and markets than to other ways of establishing rights to resources and allocating them, such as regulation and politics. There are several reasons for this bias. First, individual choice and private ownership are compatible with the set of liberal, consequentialist, and welfare-centered values that underlie mainstream economics. In contrast, collective choice and ownership are often more compatible with deontic ethical premises emphasizing equity, rights, and duties. As economic analysis of collective ownership and political allocation often centers on their welfare implications, their equity aspects – which may often alone justify their very existence

– are left without attention. This dissonance with the values underlying economic analysis and the rationale of policy instruments that constitute arrangements of collective ownership and political allocation explains why the latter receive so unfavorable evaluations.

However, the range of moral considerations accounted for in economic analysis can be extended. The works of, for example, Amartya Sen (1982), Mark Sagoff (1988), and Daniel M. Hausman and Michael S. McPherson (1996) call for and examine the consequences of treating economic agents as more than just maximizers of their economic self-interest. When other moral objectives, such as care for the well-being of other humans, the community, or the natural environment are allowed for the agents, institutions become means for attaining them. That is, institutions are not merely means to improved welfare; they are more fundamentally instruments for achieving any visions of the good society. Therefore, we should pay attention to how institutions influence the achievement of objectives actually sought by economic actors and not look only at their welfare implications (e.g. Bromley 1991; Griffin 1995; Vatn and Bromley 1997).

The second reason for the reluctance of law and economics to examine institutions of collective ownership and political allocation are that these institutions are often complex and therefore difficult to abstract and analyze. To appreciate this, one just needs to take a look at the provisions of the Clean Water Act, the numerous court cases that have clarified the meaning of the Act, the regulations of the EPA, and the states' plans for implementing their programs.

Fortunately, research in common property can offer a conceptual framework with which it is possible to examine the structure of complex institutional arrangements in greater detail than the notion of institutions in law and economics would allow. Law and economics understands that environmental institutions define the opportunity sets – rights and duties – of economic actors vis-à-vis environmental resources. Research in common property in turn argues that institutions create those rights and duties 1) by operational rules that directly constrain or open up alternatives that are available for the economic actors, and 2) by rules of collective choice that regulate the participation of actors in the formulation of operational rules (Oakerson 1992; Schlager and Ostrom 1992). *Operational rules* indicate who are authorized to use the resource in question and how those authorized users may make use of it. In the following, I will call these rules exclusion and use rules, respectively. *Rules of collective choice* pertain to how collective choices over the operational rules and the alienation of the resource can be made. These rules regulate who can participate in collective choices, how collective choices can be arrived at, what their legitimate distributional effects are, and what remedies are available for those whose operational or collective choice rights have been violated (see Oakerson 1992). They could be called suffrage, distribution, decision and conflict resolution rules, respectively.

The structure and rules of an ownership arrangement determine its nature. It is now typical to speak of open access, state property, common property, and private property as the four main ownership regimes (see e.g. Bromley 1991). McKay (1996) has suggested that it would be sufficient to distinguish only between open access, common property, and private property or, as I would put it, between *res nullius*, collective ownership, and private ownership. There is analytical merit in collapsing state property into private and common property; the state holds some resources merely as private property, alienable at its will, while with respect to other resources, it only serves as an arena for collective choice and conflict resolution, thereby rendering it but a functional part of a large-scale formal common property arrangement (see e.g. the discussion on the doctrine of public trust in *Commonwealth v. City of Newport News* 1932).

McKay (1996) has also argued that we should pay more attention to how ownership institutions constitute the management of resources. She identifies laissez-faire and market, communal, state, and international governance as the major ways to organize resource management. Her categories illuminate that resource management may be unorganized (that is, be allocated to users and uses on the basis of capture, priority of use, waiting, or other informal rules of rationing), be based on market allocation, or be carried out politically at different jurisdictional or geographical levels; depending on, for example, whether the rights created by the rules of the ownership arrangement are transferable or not. However, these distinctions do not exhaust all the alternative ways to manage resources under any ownership arrangement.

On the basis of the general ideas presented in research in common property (see Ostrom 1990; Oakerson 1992; Schlager and Ostrom 1992; McKean 1992; McKay 1996), I suggest that a more detailed analysis can be based on identifying how an ownership arrangement with its various functions is structured and how it organizes resource management. I propose to understand 1) exclusion, 2) regulation of resource use, 3) monitoring of resource use, 4) enforcement of the rules of exclusion and use, 5) collective choice, 6) distribution of the costs and benefits of resource use, and 7) conflict resolution as the major functions organized by any ownership arrangement. These functions are shaped by operational and collective choice rules and implemented by organizing the functions in particular ways in particular resource use contexts.

This framework is applicable to the analysis of both conventional small-scale common property arrangements and contemporary environmental policies. The management of a small environmental resource such as a pasture or a forest lot may be based on an organization of resource owners that can decide on its alienation and who is authorized to use it and how. This organization may also monitor resource use, enforce its rules, and serve as the arena of conflict resolution (see Netting 1981; McKean 1992). In contrast, only legislatures may hold *de jure* right to alienate larger environmental resources such as air and water basins used as waste sinks. Environmental policies determine, how collective ownership and resource management will be established and organized in these resource use contexts. The rules of exclusion and use with respect to large environmental resources may be devised in part in the legislature and in part in administrative agencies. The monitoring of resource use and the enforcement of its rules may be carried out by administrative agencies or be delegated to resource users or to their collectives. Conflicts may in turn be resolved within the administration, in the courts, and/or in the legislature.

Law and economics can add to the depth of analysis once environmental policies have been conceptualized as institutions of ownership and resource management that prevail in the world of positive transaction costs. Transaction costs are costs of obtaining information, negotiating, and enforcement that engender interest conflicts and coordination problems in the society (see Arrow 1974; Dahlman 1979; North 1981; Libecap 1986). Law and economics often understands institutions as economizing on transaction costs. For example, environmental policies may reduce the efforts needed to overcome uncertainty and conflicts over the use of environmental resources by defining the rights of economic actors to them. They could thus be seen to improve the efficiency of the economy and economic welfare by releasing resources from transacting to production (North 1981). Consequently, research in law and economics has been mainly interested in identifying and promoting institutional arrangements that would reduce transaction costs. However, this approach has not acknowledged social ends other than the improvement of economic efficiency or welfare (see Sagoff 1988).

It would be better to understand that the formulation of institutions affects the achievement of

whatever objectives the agents consider important. That is, welfare maximization and other social objectives such as the protection of public health or the environment could be better seen as historically contingent moral values that inform economic actors. These values motivate the establishment of those institutions and rights which have been perceived as conducive to the realization of these values. The formulation of the rules that create rights in part determines how costly the monitoring of resource use and the enforcement of its rules will be (Field 1989; Eggertsson 1996), and thus affects to what degree any objectives of resource use can be achieved. The formulation of the rules also allocates the costs of governance to economic actors and regulates their effective participation in collective choices. Naturally, the physical characteristics of the resource, such as the level of exclusion costs the resource entails or the rivalry or incompatibility in its use, also influence the costs of monitoring and enforcement (see Schmid 1987).

Although it is impossible to measure the exact transaction cost implications of institutional arrangements, it is possible to judge the level of transaction costs implied by choosing one alternative over another. This kind of comparative analysis first identifies the structure or rules of the institutional arrangement to be assessed, then finds their functional alternatives, and assesses the relative implications of the chosen institutional arrangements or their rule formulations. Finally, the analysis deduces the effects of choosing a particular formulation of an institutional arrangement over other possible formulations on the achievement of objectives considered important in a particular resource use context. This approach compares institutional arrangements and their rule formulations to their actual real world alternatives rather than to some hypothetical ideal (see Demsetz 1969). However, it departs from the usual welfarist approaches in law and economics by acknowledging the existence of objectives other than welfare maximization.

In what follows, I will demonstrate the usefulness of the outlined analysis by examining the main regimes of water pollution control policy in the United States since the 1850s.

2. The Common Law Regime of Water Pollution Control, 1850-1900

Water pollution increased in the United States along with industrialization and urbanization, and it had created local problems by the early 19th century. Industrial discharges were the leading polluters of water until the 1880s. Most early industrial establishments were water-powered and thus located at watercourses: discharging wastes into water was simply the easiest way to get rid of them. Another reason for the predominance of industrial wastes as water pollutants was that most localities were still small and lacked sewers. (Paavola 1997)

The character of industrial effluents determined the injuries they created. First sawmills, tanneries, and textile mills; then ore and coal mines; and later also dairies, canneries, packaging houses, and pulp manufactories discharged effluents that often contained solids and had sometimes high biological oxygen demand. These discharges interfered with the use of water power and production in the downstream mills; injured the use of water for domestic, livestock, and agricultural purposes at riparian farms; were sometimes deposited on riparian land; and filled up the riverbeds, obstructed navigation, and destroyed fisheries. In short, industrial effluents mainly injured the property of the downstream mill-owners and riparian farmers and sometimes interfered with public rights to navigation and fishing. (Paavola 1997)

Common law doctrine of riparian rights had traditionally availed remedies for those whose use of water was injured. The doctrine of private nuisance provided remedies when water pollution interfered with a use of land. Finally, if water pollution obstructed navigation or interfered with some other public right or interest, the doctrine of public nuisance could provide relief (Farnham

1904). In what follows, I will focus on riparian law, as it was the most important legal response to early industrial water pollution. My account draws from the analysis of dozens of early water pollution cases and other works on water law, water pollution, and its control (see Davis 1971; Horwitz 1977; Rose 1994; Scott and Coustalin 1995; Paavola 1997).

Riparian law constituted an ownership arrangement that entitled all riparians to the use of water in the streams which flowed past their land. It made the riparians co-owners of the watercourse and formally excluded non-riparians from the use of water. The riparians' rights were limited only to the use of water: they had to return it to the stream so that also lower riparians could exercise their rights to it. Moreover, the riparians were not to interfere with the public right to navigation. The riparians could transfer their rights to the use or quality of water to another riparian by voluntary exchange. The courts could also effectuate a transfer of riparian rights from an injured riparian to an adverse water user for free by declaring the injurious water use reasonable or at a certain price by awarding damages for the injured party. Thus the rights to water use established by this ownership arrangement almost amounted to private property.

As their incompatible uses of water for power generation, waste disposal, and for domestic, livestock, and agricultural purposes increasingly injured each other, the riparians' formally equal rights resulted in numerous resource use conflicts (see Davis 1971; Steinberg 1990; Paavola 1997). This experience indicates that watercourses are multiple use common-pool resources akin to forests. Namely, the depositing of wastes competes with other uses of water and the polluters vie for the use of the assimilative capacity of waters. It is also difficult to exclude unauthorized dischargers or discharges from a watercourse. These resource characteristics influence what resource use problems are likely to emerge and also influence how policy responses perform in resolving these problems (Schmid 1987). However, in what follows, I will focus mainly on how the *formulation* of the ownership arrangement affects which interests in the use of water resources will count and to which degree their multiple use is possible.

Over time, common law generated several rules of use to resolve conflicts over the pollution of water by industrial discharges. A seniority rule affirming the more ancient of the incompatible water uses had been used in Great Britain from early on (Scott and Coustalin, 1995). However, it lost its usefulness when streams became intensively used for power generation, depositing of wastes, and water supply, and when most users could claim their rights to have existed since time immemorial. As a response to increasing industrial pollution, British judges adopted in the 1820s the doctrine of natural flow which entitled the lower riparians to undiminished quantity and quality of water (*ibid.*). It was considered problematic in the United States because it threatened the existence of the young mill industry. Justice Story resolved the dilemma in *Tyler v. Wilkinson* in 1827 by formulating the doctrine of reasonable use, which allowed some diminution in the quantity or quality of water if it did not materially injure the downstream riparians.

Most states adopted some formulation of reasonable use in the 19th century. Many states followed Story's definition of reasonable use as one that did not materially injure the lower riparians. The second formulation of the doctrine was a balancing test, which was used to identify the more valuable water use and to endorse it. It was first used in water pollution litigation in the Vermont case of *Snow v. Parsons* (1856) and was later adopted also in New Hampshire and Wisconsin, for example. The third variant of reasonable use, formulated in *Pennsylvania Coal Co. v. Sanderson* (1886), exempted mining from liability in water pollution suits altogether because public interest was perceived to lay in its side. The formulation of reasonable use influenced whose interests prevailed in conflicts between incompatible uses of water. The use rules prohibiting material injury protected

traditional riparian uses of water, while balancing and exemptions favored capital-intensive developmental water uses. Some courts rejected the balancing test because of its problematic distributive consequences (see e.g. *Strobel v. Kerr Salt Co.* 1900).

Common law delegated the monitoring of resource use to the riparians themselves. The detection of non-riparians' unauthorized use of water was easy, as the riparians' land abutted to the watercourses from both sides. The solids contained in early industrial effluents made it easy to notice when one's own water use was injured (in contrast, later it became difficult to detect bacterial or toxic pollution) and facilitated the identification of responsible dischargers. Frequently the proximity of dischargers and those injured by water pollution contributed to the same end. However, it was not easy to determine whether a polluter was within his or her rights to discharge effluents into a watercourse: costly litigation was needed to resolve it.

Common law delegated the enforcement of riparian rights to the riparians. Namely, the riparians whose rights had been injured could bring a suit in a court and obtain relief – damages or/and an injunction – if the polluter's use of water was unreasonable. Actions against non-riparians were rare, but non-riparians such as the City of Battle Creek in the Michigan case of *People v. Hulbert* (1902) were sometimes denied standing or relief when they challenged the pollution of water by a riparian. In contrast, litigation was intense among the riparians (see Davis 1971; Paavola 1997). Private enforcement of riparian rights allocated enforcement costs initially to the injured plaintiffs, but the courts could alter the distribution of litigation costs. As the water use of traditional riparians rarely generated remarkable revenues, they could seldom profitably initiate costly litigation to defend their rights. Moreover, the benefits of enforcing riparian rights were available for those who did not go to the court, thereby inviting free riding. Several plaintiffs could enforce riparian rights together (see *Strobel v. Kerr Salt Co.* 1900) and sometimes, as in the California case *Woodruff v. North Bloomfield Gravel Mining Co.* (1883), the courts joined several defendants in one suit. These solutions reduced enforcement costs for the riparians involved in litigation, but it was still costly for them to cooperate and the incentives to ride free remained intact. Thus the enforcement of riparian rights was worthwhile mainly when a favorable outcome was relatively certain or when a more valuable water use had been injured.

Riparian law did not constitute any organization of resource users for collective action and deliberated collective choice; collective choices over the rules of water use emerged as the aggregate results of individual actions at the market and in the courts. This structural feature limited effective participation in collective choices to judges and riparians. The riparians presented conflicts for the judges to resolve and participated in collective choice according to their ability and willingness to pay for their use of water and litigation. The judges had some freedom to formulate rules of water use, given the constraints imposed by the inherited legal framework; the stream of conflicts presented to them; and the then-prevailing values that emphasized economic growth and developmental uses of resources (see Kelley 1959; Hurst 1964; Horwitz 1977; Steinberg 1991). Riparian law did not grant collective choice rights to those interests in water quality that were not associated with the ownership of riparian land, such as the interests in public health or fishing; nor could it protect them. However, non-riparian interests in water quality could seek protection in private and public nuisance suits or from the legislature.

To conclude, riparian law constituted an ownership arrangement that formally excluded non-riparians from and entitled riparians to the use of water. Different rules emerged to regulate the riparians' incompatible uses of water. This ownership arrangement left the monitoring of resource use and the enforcement of exclusion and use rules to the resource users themselves. The courts

served as the arena of conflict resolution and had an important role together with the markets as an arena of collective choice. Riparian law thus constituted uses of water as private property and left the management of water quality for the market and the courts. These structural features had important consequences.

The use rules that enabled some diminution in the quality of water, that transferred rights to water quality to the higher valued water uses, or that exempted dischargers from liability altogether, often allowed the early industrial establishments to get rid of their wastes without interference. The injured riparians had to carry the costs of enforcing their rights in the courts and seldom had economic incentives to do so. In fact, it was in their interests to be free riders. Riparian law thus gave effect to the interests in using watercourses for disposing of wastes. The polluters could deposit wastes into watercourses for free if the injured riparians did not challenge it or if it was deemed reasonable by a court. The polluters could also continue discharging wastes even after successful litigation by the injured plaintiffs, as common law only aimed at economic restitution of the value of lost water use. Namely, a law court could award damages to the plaintiff as a remedy for past injuries and thereby effectuate an ex post right transfer from the plaintiff to the polluter. When a court of equity granted an injunction, it entitled the plaintiff to price her water use herself and required the polluter to acquire the plaintiff's right to continue polluting. The polluter could typically strike a deal. However, the defendant pulp mill in the New York case of *Whalen v. Union Bag & Paper* (1918) could not do so and had to shut down (see discussion on that case in *Driscoll v. American Hide & Leather Co.* 1918).

The polluters could thus deposit wastes into the watercourses either freely or by compensating those injured by their discharges. As a governance structure, the riparian law was informed by and gave effect to the contemporary values that emphasized developmental use of natural and environmental resources for fueling economic growth. It did not protect the interests of traditional riparians in their customary water uses, that had depended on some minimum quality of water. Nor did it protect the pecuniary value of their customary water uses.

3. The Statutory State Water Pollution Control Programs, 1900-1950

Industrializing cities grew rapidly in the 19th century United States, and their growing population worsened urban living conditions in terms of noise, polluted air and water, inadequate waste disposal, and epidemics of water-borne and other diseases. American cities constructed water works and sewer systems especially after the Civil War to safeguard public health (Tarr 1996). As a consequence, municipal sewage discharges replaced industrial effluents as the predominant water pollutant in the last decades of the 19th century.

Like industrial discharges had done earlier, sewage discharges interfered with the use of water power and production in the downstream mills; injured the use of water for domestic, livestock, and agricultural purposes at riparian farms; and filled up the riverbeds, obstructed navigation, and destroyed fisheries. However, sewage discharges also endangered public health by spreading water-borne diseases, such as cholera, typhoid, and dysentery. The adverse public health effects of sewage discharges became more severe as water works became more common as suppliers of water for domestic use. Namely, water supply systems effectively conveyed water-borne diseases by distributing contaminated water to consumers. (Paavola 1997)

Common law protected private property from the injuries created by sewage discharges, with the same implications as there were regarding early industrial effluents. However, the protection of public health presented a different problem for policy makers. After experimenting with public

nuisance suits and local ordinances, at the turn of the century many states enacted water pollution control statutes that aimed at protecting public health. In what follows, I will examine these programs in greater detail. My analysis draws from compilations of early state water pollution control statutes (see Goodell 1905; Montgomery and Phelps 1918; Special Advisory Committee on Water Pollution 1935, 1939), dozens of court cases, and secondary literature on water pollution, its control, and the history of public health (e.g. Flannery 1956, Murphy 1961; Hines 1966a; Rosenkranz 1972; Duffy 1974; Tarr 1996).

Early water pollution control statutes made the public a co-owner of the watercourses along with the riparians and sought to exclude such discharges into water that were injurious to the public's health. However, although these programs authorized intervention to abate discharges that were injurious to public health and sometimes prohibited new discharges, they did not provide a clear rule of exclusion. The absence of a general discharge prohibition forced the water pollution control authorities to determine case by case, and usually *ex post*, whether a polluter was entitled to deposit wastes into a watercourse. This made it difficult to prevent discharges that endangered public health. The early programs also contained many exemptions. In some states, the depositing of wastes was excluded only from streams from which water was taken for public use. Other states exempted all existing discharges or all or some industrial discharges, typically those of the industries that were important for the state's economy. Finally, sometimes water pollution control statutes did not apply to the most intensively polluted watercourses (see Goodell 1905; Montgomery and Phelps 1918). Most exemptions disappeared by the 1950s, but the rule of exclusion remained ambiguously defined (see Flannery 1956).

Water pollution control authorities were typically authorized to formulate the rules of water use. They could determine these rules *ex ante* as conditions of the discharge permits issued to polluters or *ex post* in the abatement orders. The practice varied from state to state. Only a few states established permit programs early on (see Goodell 1905; Montgomery and Phelps 1918). The use of *ex post* rules provided relatively wide discretion to the authorities in whether, when, and how they formulated the rules of use. The rules of use were later based on a few main approaches. In states such as Pennsylvania and New York, bodies of water and sections thereof were zoned for public water supply, recreation, industrial use, or the depositing of wastes (Flannery 1956; *Town of Waterford v. Water Pollution Control Board* 1959). Water quality standards were then established for each designated water use. If they were not met or were threatened, the authorities determined the discharge reduction required to meet the standards and allocated it to polluters. In other states, for example in California, Wisconsin, and Michigan, the rules of use were based either on a general discharge prohibition and discharge permits or required specific performance such as a specified level of purification or reduction of pollutants (Flannery 1956; *City of Niles v. Stream Control Commission* 1941).

Water pollution control authorities also monitored the use of water for depositing wastes. It was still difficult to detect bacterial contamination and its source at the turn of the century, and it was even more difficult to prove that it endangered public health. For example, the plaintiff's expert witnesses in *Missouri v. Illinois* (1901, 1906) released barrels of solution containing cultured bacteria to persuade the U.S. Supreme Court that Chicago's sewage discharges to the Illinois River could endanger the health of its citizens in St. Louis. The defendant's expert witnesses in turn floated permeable leather sacks containing typhoid bacteria solution, successfully persuading the court that the plaintiff's evidence was not sufficient. What was sufficient evidence remained an important issue in water pollution litigation throughout the early 20th century. Also the modest

resources of water pollution control authorities weakened the monitoring of water use before the Second World War (Kehoe 1997).

Enforcement activities were also delegated to water pollution control authorities: they could persuade the polluters to reduce their discharges voluntarily, issue abatement orders, or sue recalcitrant polluters. While all these enforcement measures were used, water pollution control authorities were reluctant to initiate actions in the court against industrial polluters: they believed that voluntary cooperation was the most desirable and feasible strategy to abate industrial water pollution (Flannery 1956; Murphy 1961; Kehoe 1997). Moreover, litigation demanded more resources than did persuasion or administrative enforcement measures. Water pollution control authorities could also decide not to enforce the rules of water use, as happened in some states after filtration and chlorination of drinking water had abolished the hazard sewage pollution posed to public health (Kehoe 1997). Thus often only common law rules that protected private property from water pollution remained in effect. Even they were sometimes suspended, as happened in the Washington case *Ellison v. Rayonier Inc.* (1957).

Collective choices over the rules of water use were made in several arenas, but the legislatures held the supreme power to shape them. Industrial interests could typically muster broad support to encourage economic development and to oppose initiatives such as water pollution control policies that were seen as inimical to it. Also the spokespersons of local communities were opposed to water pollution control policies because they increased their tax and/or debt burden. Conservation movements such as the *Izaak Walton League* gained some leverage in the state legislatures in the 1920s (see Flannery 1956; Scarpino 1985; Kehoe 1997). Early water pollution control programs thus often reflected the interests of industrial and municipal polluters in lenient requirements, lax enforcement, and ineffective sanctions.

Water pollution control authorities also participated in collective choices as the formulation of use rules was delegated to them. The Progressive Era's trust in expertise and efficiency led to the foreclosure of administrative decision-making from the public which exposed the administration to capture by its clients. Water pollution control authorities and polluters did share many views; both supported the full use of the capacity of waters to assimilate wastes, and both extolled voluntary cooperation in control of water pollution (Kehoe 1997). Many states later established boards, committees, or commissions – in which administration, industry, municipalities, and conservationists could be represented – to implement water pollution control programs (Flannery 1965; Hines 1966a; Kehoe 1997). Water pollution control programs thus geared toward the management of watercourses for disposing of wastes. The fact that collective choices over the use of waters were made by persons only weakly accountable for their conduct often translated into lenient programs and lax enforcement. This governance structure broke down in the late 1940s under public outrage in some places such as Wisconsin (Flannery 1956).

The courts and the legislatures were also the primary conflict resolution arenas. Polluters had economic incentives to dispute rules that imposed abatement costs on them (see e.g. *State Water Commission v. City of Norwich* 1954, p. 275) and successfully used the courts to avoid and to delay abatement. For example, the Connecticut authorities had been trying to have the City of Derby to reduce its discharges since 1927 but the city was still litigating in 1961 (*City of Derby v. Water Resources Commission* 1961). The conservation movements or the parties injured by water pollution did not get any hearing in the courts under the water pollution control statutes, but the injured could challenge pollution under common law as was done, for example, in *Columbia River Fishermen's Protective Union v. City of St. Helens* (1939). For these parties, the legislatures were

the only arena in which they could dispute the rules of water use created by water pollution control programs or the way in which they were enforced. They did so increasingly in the late 1920s and thereafter (see Scarpino 1985; Kehoe 1997) but with only modest success. Industrial interests and local communities had strong holds of most state legislatures and could successfully protect their interests in the use of waters.

To conclude, early statutory water pollution control programs constituted arrangements of collective ownership that first incorporated only vague rules of exclusion and contained many exemptions. The formulation, monitoring, and enforcement of the rules of water use was delegated to state water pollution control authorities. Collective choices were first made by the legislatures and water pollution control authorities, and later by boards or commissions based on interest group representation. The courts and the legislatures were also arenas of conflict resolution. While statutory water pollution control programs did not preempt common law rules, water pollution control litigation became less frequent after their establishment and the statutes confined the courts and the markets as arenas of collective choice to those outcomes they permitted. In short, statutory water pollution control programs made political allocation the dominant mode of governing the use of waters for disposing of wastes.

The early water pollution control programs had only a limited impact on water quality because their rules of exclusion were vague and contained so many exemptions. Although most exemptions were later eliminated, the performance of statutory water pollution control programs remained weak. First, the polluters could avoid or postpone compliance with use rules by challenging them both in the administration and in the courts. Second, it was oftentimes difficult to verify whether the polluters complied with the use rules or even to know whether the use rules would have the desired impact on the watercourses if complied with. Third, the latitude of discretion given to water pollution control authorities allowed them to eschew enforcement activities once the development of water treatment technologies had eliminated the threat sewage pollution had posed for public health. The effect of this latitude was especially pronounced in the lax treatment of industrial polluters.

Early water pollution control programs thus facilitated the use of watercourses for depositing wastes, although they were enacted to protect public health. These programs were rendered obsolete in the eyes of the contemporary public health and sanitary engineering professions by the development of water analysis, filtration, and chlorination that effectively safeguarded the public health from the dangers of contaminated water. As administrative decision-making was protected from public interference, those who had different views on how waters should be used could only resort to the legislatures – in which the polluters had strong position – to change the rules of water use. This demonstrates how strongly the performance of an institutional arrangement is dependent on the match between its purpose and the values prevailing in the society, and on the structural features that determine how values are translated into policy.

4. The Federal Water Pollution Control Program, 1948-1980

Two major developments have shaped water pollution as a policy problem in the 20th century. First, conventional water pollution problems had expanded and had already caused interstate effects by the early 20th century. Second, while suspended solids, caustic and acid substances, and substances with high biological oxygen demand still formed the bulk of industrial effluents, toxic chemicals became more common. For example, coking processes polluted water supplies with phenols that interacted with the chlorination of drinking water and caused persistent taste prob-

lems around the First World War (Tarr 1996). Also oil industry had caused numerous spills by the same time. Finally, new pesticides such as DDT were developed during the Second World War, manufactured for civilian use thereafter, and were spilled to watercourses.

The expansion of the scale of water pollution problems made it difficult for the states to control them on their own. Often the benefits of one state's abatement efforts were enjoyed by other states. Moreover, states in which demands for stronger water pollution control programs arose were threatened by the flight of industry to more lenient states. So again, it was best to wait for the others to take action and to ride free. Still, conventional discharges from one state could cause considerable injuries in another. New chemicals could in turn create massive effects as was demonstrated by the enormous fish kills in the Mississippi River and elsewhere in the 1950s and the 1960s (see Carson 1962; Graham 1966; Zwick and Benstock 1971).

It proved difficult to resolve inter-jurisdictional water pollution problems, despite attempts that started early on. A federal statute prohibited the dumping of solid wastes into watercourses in 1899 and another act sought to control oil pollution in 1924 (Hines 1967). The states also initiated actions such as *Missouri v. Illinois* (1901, 1906) in the U.S. Supreme Court to challenge water pollution that originated from another state. The first interstate compacts to control water pollution were adopted in the 1930s (Hines 1966b; Cleary 1967). Efforts toward federal water pollution control legislation started in 1934, but it was not enacted before 1948 (Flannery 1956; Hines 1967). The contemporary federal water pollution control program got its shape finally in 1972. In what follows, I will examine in greater detail the federal program by analyzing federal water pollution control statutes, court cases, and secondary works on water pollution and its control (e.g. Scarpino 1985; Yeager 1990; Kehoe 1997).

In the beginning, the federal water pollution control program made riparian states the co-owners of interstate waters. This arrangement of collective ownership, like the contemporary state programs, did not include a clear rule of exclusion and established only a few rules of water use. Namely, the federal program first denied only such depositing of wastes that endangered the health or welfare of the citizens of another state. During the 1960s, the federal program's potential applicability expanded to all navigable waters. The Water Quality Act of 1965 took a step toward better specified rules of use by requiring the states to establish water quality criteria for the interstate waters within their boundaries and plans for implementing them. However, the establishment of these criteria and their implementation plans progressed very slowly (see Zwick and Benstock 1971). The Water Quality Improvement Act of 1970 established additional rules of use vis-à-vis the discharges of oil, toxic substances, and discharges from watercraft.

The FWPCA Amendments of 1972 reformed this arrangement of collective ownership by prohibiting all unauthorized discharges and by establishing abatement goals for both conventional and toxic pollutants. These goals informed the specification of use rules that was delegated to the EPA. The rules of use could be based on technological performance criteria established for categories and classes of point sources or be determined so as to maintain applicable water quality standards. Use rules establishing performance requirements on the basis of technological considerations predominated in practice (Yeager 1990). A permit system specified the rules of use for individual polluters. The EPA could delegate its implementation to states after finding their plans of doing so acceptable.

The rules of use outlined in the FWPCA Amendments of 1972 proved burdensome to establish. While all significant dischargers of conventional pollutants were licensed during the 1970s, the last performance criteria for toxic pollutants were promulgated as late as in the end of the

1980s (Yeager 1990). Moreover, the use rules that were based on technological performance criteria – while not very costly to monitor and enforce – did not have a direct relationship to water quality. Finally, the FWPCA Amendments of 1972 did not establish rules of use for non-point sources, even though they accounted for over a half of conventional pollutants and contributed to toxic pollution (Yeager 1990; Adler, Landman, and Cameron 1993).

Federal monitoring of water use predated the federal water pollution control program by almost four decades. Namely, the Public Health Service was authorized to study water pollution in 1912 and had since conducted extensive investigations of water pollution. However, its research was long aimed at understanding how pollution affected watercourses: it was not directly focused on whether the polluters complied with the rules of water use (Zwick and Benstock 1971). The lack of clearly specified rules of exclusion and use was at the root of the problem; it was difficult to monitor compliance with non-existing or vague rules.

The FWPCA Amendments of 1972 established a clearer rule of exclusion and required permits. The permit conditions specifying the character and amount of pollutants allowed within a period of time made the monitoring of resource use easier. It was also easy to monitor the conformance with compliance schedules, while it was more difficult to determine whether the non-conformance had resulted from the lack of good-faith attempt or despite of it. Self-reporting requirements also facilitated monitoring of resource use. Self-reporting was supplemented by random checks of the truthfulness and accuracy of the reports (Yeager 1990). However, continuous monitoring of the numerous dischargers and frequent checks of their self-reporting would have been prohibitively expensive. Therefore, the monitoring of water use still remained only partial.

At first, enforcement of the federal rules of water use was practically impossible. The conference procedure established in 1956 directed the administrator to notify the state from which interstate pollution originated and to call a conference to make recommendations for the abatement of pollution. If the polluters took no action, the state could be recommended to do so. If the state did not act within six months, a hearing could be arranged to make findings about the existence and abatement of interstate pollution. If the polluters still took no timely action, the Attorney General could be requested, upon the approval of the state, to bring a suit to secure abatement. This cumbersome enforcement procedure made it the administrator's burden to establish that pollution endangering health or welfare in another state existed and how it could be abated. Moreover, the administrator had relatively wide discretion whether to initiate and to proceed in enforcement activities. As a consequence, only 51 enforcement conferences were ever called, only four hearings were arranged, and only one polluter – the City of St. Joseph, Missouri – was taken to the court (Zwick and Benstock 1971, 432-437).

The FWPCA Amendments of 1972 mandated an enforcement response to non-compliance with the federal rules of water use and availed administrative, civil and criminal sanctions for the purpose. In practice, sanctions were applied in a graduated manner. Those polluters whose permits were pending or were based on temporary performance criteria were not subject to standard enforcement. Informal contacts, letters of notification, and compliance orders were used in ordinary cases and self-reporting requirements and compliance schedules were enforced more strictly than effluent limitations. Civil and criminal sanctions were used against repeat offenders and negligent or willful violators (Yeager 1990). The administrator retained enforcement power where state authorities implemented the program. The act also availed citizen suits to enforce the rules of water use or to compel the administrator to act. However, while they provided a check on the administrator's discretion, citizen suits never became central tools of enforcement.

Collective choices over the federal rules of water use first were made in the enforcement conferences. Federal and state water pollution control authorities and state governors could request federal intervention and participate in collective choices with other affected parties. The courts could have been used by the polluters to challenge the rules of use had the need arisen. Other parties interested in the quality of water for environmental, recreational, or esthetic reasons could not have done so because they were denied standing before the landmark case of *Scenic Hudson Preservation Conference v. Federal Power Commission* in 1965. Water pollution control authorities thus had broad discretion whether and how to formulate rules of water use (Zwick and Benstock 1971). As it was difficult to compel them to act, they long made important collective choices over the use of waters by discretionary inaction.

The FWPCA Amendments of 1972 made administrative rule-making and adjudication the primary arenas in which the water pollution control authorities, the polluters, and environmental and other groups made collective choices. These parties could formulate the rules of water use within the limits set forth by the provisions of the Amendments. The Administrative Procedures Act, changes in the criteria of standing, and the citizen suit provisions now availed the courts for a wider set of interests as an arena of conflict resolution through which it was also possible to influence collective choices. In part as a result of these structural changes, environmental litigation groups successfully used the courts in the 1970s to challenge the proposed or promulgated rules of water use and to compel the administrator to act (Yeager 1990). However, the formulation of the rules of water use on the basis of performance criteria often involved complex technical issues which limited effective participation of citizen groups (McGarity 1983; Yeager 1990). The legislature remained the ultimate arena for collective choice: it was employed, for example, to amend the federal rules of water use in 1977.

To conclude, the federal water pollution control program established an arrangement of collective ownership to govern the use of waters for depositing wastes. While this arrangement was first formulated so that it accounted for little more than *res nullius*, it gradually established better specified rules of exclusion and use, facilitated closer monitoring of resource use, became better enforceable, and awarded effective protection to other than the polluters' interests in water quality. It first only complemented the arrangements of collective ownership created by state water pollution control statutes by governing the pollution of only interstate waters, but in the end, completely replaced them. However, the federal program did not totally centralize the governance of water quality; it allowed for a nested institutional and organizational structure in which the states could administer the federal program.

The federal program still remained problematic after 1972. The burdens of establishing the arrangement of collective ownership itself and of promulgating the rules of water use as outlined in the FWPCA Amendments of 1972 were so great that the program did not achieve its potential performance in its first decade of existence. The use rules it established in practice were also only weakly related to water quality. Moreover, although this collective ownership arrangement formally and in practice facilitated the participation of interest groups other than the polluters in the formation of use rules, their participation still remained hindered because of the way the collective choices were arrived at. Finally, this arrangement of collective ownership failed to establish any rules of use for non-point sources which were contributing over a half of the total load of conventional pollutants.

Conclusions

Research in common property facilitates an understanding of environmental policies as ownership arrangements, which is especially useful when combined with law and economics. It also helps to understand pollution problems as problems of resource use, which draws attention to the challenges that the attributes of environmental resources, such as rivalry in their use and high exclusion costs, present for their ownership and management. It also draws attention to the size and power of resource user groups. Finally, this approach can also acknowledge that agents may sometimes prefer courses of action that do not improve their welfare. In short, understanding environmental policies as ownership arrangements facilitates an analysis of the factors that lead to the adoption of an environmental policy, explain its rationale, and affect its consequences.

For example, my analysis demonstrates that new water uses and changes in social structures that have allowed new groups of water users to voice their concerns have created pressures to modify water pollution control policies. Institutions that govern the use of watercourses for depositing wastes were first based on transferable rights and their market allocation, were compatible with the mid-19th century liberal values that emphasized economic development, and mainly protected property interests in water quality. The concerns for public health that gained foothold thereafter promoted the use of water for the public water supply and the construction of sewers to dispose of used water, and created their own policy problem. The statutory water pollution control programs that sought to realize these public health concerns were also slow to widen the scope of interests they protected. Finally, the use of waters for recreation and the concerns in environmental protection presented their own demands for the use of waters for depositing wastes and shaped the federal water pollution control program in particular. These observations underline that water pollution control policies have changed to resolve conflicts between interests in water quality and that they reflect the balance of power between the interest groups.

Research in common property offers also a structural model of ownership arrangements that, together with the views of law and economics on the transaction cost implications of institutional arrangements, facilitates the analysis of the consequences of formulating environmental policies in a particular way. This model draws attention to how an environmental policy constitutes the ownership and management of an environmental resource, which in part determines how costly it is to exclude unauthorized users, to monitor resource use, and to enforce its rules. The formulation of an environmental policy also determines who can dispute the rules of resource use or their violation by other resource users, and who can participate in collective choices over these rules. In this way, this model helps to examine how a particular formulation of an environmental policy contributes to the achievement of any resource use objectives in the real world. The observations made by using this model are also useful for the design and implementation of environmental policies.

For example, the way common law formulated rules of water use and organized the monitoring of water use and the enforcement of its rules provided only weak protection for private property. Moreover, the way common law organized conflict resolution and structured participation in collective choice made it difficult for all but especially other than property interests to seek protection. The solution – statutory water pollution control programs – was rendered obsolete in the eyes of the water pollution control authorities by developments in bacteriology and water treatment which had made the prevention of pollution unnecessary for the protection of public health. The discretion awarded to water pollution control authorities made it possible for them not to enforce rules of water use and not to protect the new interests in water quality that had arisen

meanwhile. The Clean Water Act of 1972 improved the governance of water quality and established checks for the power of its administrator. However, it did not govern all important sources of pollution, in part because it was difficult to devise enforceable rules for the purpose. These observations indicate that the economics of governance is important for the design and implementation of environmental policies.

While my paper has focused on extending some ideas of common property research to the analysis of environmental policies, doing so could also have implications for the research in common property. This research has focused on the emergence of informal common property arrangements, has often used game theoretic approaches to study it, and has treated it as somewhat different from deliberate policy design and choice. However, formal legal institutions such as environmental policies are also brought about by collective action. This collective action is not automatically forthcoming in this context either; it presents similar challenges to interest groups than the establishment of a conventional common property arrangement. The evolution of formal legal institutions highlights that this collective action is driven by changing and conflicting values and is structured by institutions that regulate the participation of individuals and interest groups in collective choice. This brings us to the question what values inform and what structures regulate and how the participation in collective choices over the establishment of conventional common property arrangements. Finally, venturing in the borderlines between common property research and law and economics emphasizes the need to examine the consequences of formulating arrangements of collective ownership in a particular way. This needs not reduce institutions of collective ownership solely to instruments for improved welfare; they just as well may be vehicles for achieving other goals and deserve to be studied as such.

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