I. Wetland Economics

Public policy on wetlands, including the national goal of "no net loss" of wetlands, attempts to balance the public's interest in conserving wetlands for the benefits they provide, and landowners' interests in converting wetlands to economic uses that provide greater private benefits. While wetland economics can be understood in terms of balancing the marginal benefits of protecting and converting wetlands, in practice, difficulties with estimating those benefits limit public scrutiny to qualitative, case-by-case review of each conversion proposal.

Private and Public Roles in Wetland Economics

About 82 percent (92 million acres) of wetlands and former wetlands in the contiguous 48 States are privately owned. Historically, private owners converted wetlands to other uses to increase their productive value. For most of U.S. history, public incentives were offered to private owners to encourage wetland conversion to more productive uses in order to promote economic growth and westward expansion.

However, many interests in the remaining privately owned wetlands are public concerns. Appreciation of the public goods nature of wetland benefits and the costs associated with wetland loss or degradation has increased over the course of the 20th century. Society's interest in wetlands arises from the fact that the public benefits—providing fish and wildlife habitat, preserving water quality, storing flood waters, and so forth—extend well beyond the bounds of wetlands themselves. Wetlands perform a variety of functions that benefit the public, discussed in detail in Chapter II. What complicates wetlands as a policy issue is that many of these public goods benefits accrue to society at large or to individuals other than the wetland owners. For example, a wetland may provide habitat for migratory birds and reduce flooding on downstream properties, but fail to generate significant benefits for its owner. As a result, many private wetland owners may find it more profitable to convert wetlands to alternative uses, such as agriculture or urban development, even when such conversion is costly to society.

Wetland conversion or degradation deprives society of water quality, water quantity, fish and wildlife habitat, and recreation benefits, or increases the cost to society of replacing wetland services. Such wetland conversion or degradation in the process of development or agricultural production is said to generate "negative externalities," or unintended harmful effects on individuals other than the wetland owner.

The Private Conversion Decision: Private Gain and Public Disincentives

Private landowners decide to convert wetlands to alternative uses, like crop production or housing developments, by comparing the economic returns they expect to receive from these uses with what they would receive if the wetlands were left in their natural state. Throughout U.S. history, the Federal Government has influenced landowners by offering policies that increased returns from converting wetlands. For example, grants of wetlands to States during the 19th century paid for levees and drainage, allowing wetlands to be converted to agricultural production. Until 1985, farm program payments depended on crop base acreage, providing an incentive to create more cropland from wetlands.

More recently, public policies were enacted to decrease returns from conversion, by creating disincentives for wetland conversion or removing previous incentives. Public disincentives for wetland conversion range from regulatory review, through the dredge and fill permitting process under Section 404 of the Clean Water Act, to denying farm program payments under the Swampbuster sanctions of the 1985 Food Security Act.

The Public Restoration Decision: Public Cost and Private Gain

Beyond reducing expected returns from wetland conversion, recent policy efforts have also included efforts to enhance the returns that private landowners may receive from wetland protection and restoration. These voluntary programs offer owners of existing or former wetlands incentives to conserve or restore wetlands, thus seeking to secure the public goods threatened by or lost to conversion. The public's calculus includes the potential benefits to be gained from the wetland, balanced against the incentive needed to offset the landowner's opportunity cost of converting the wetland. The public interest in the protected or restored wetland varies from a limited agreement to repay restoration costs if wetlands are converted for programs, such as the Fish and Wildlife Service's Partners for Wildlife Program, to formal acquisition of the cropping and drainage rights for the Wetlands Reserve Program.

Socially Optimal Wetland Conversion: The Economics of "No Net Loss"

"No net loss" of wetlands is a policy goal that emerged in 1989 that has garnered bipartisan support. To date, the "no net loss" goal has been interpreted to mean wetlands should be conserved wherever possible, and that acres of wetlands converted to other uses must be offset through restoration and creation of wetlands, thus maintaining or increasing the wetland resource base.

The antecedent of the "no net loss" goal in Federal wetlands policy was the National Wetland Policy Forum. In 1987, Environmental Protection Agency Administrator Lee Thomas asked the Conservation Foundation, headed by its then-President William Reilly, to convene a blue-ribbon panel of environmental, agricultural, business, academic, and government leaders to consider ways to improve wetland regulation. The Forum concluded that "no net loss" was a reasonable goal (The Conservation Foundation, 1988):

> Although calling for a stable and eventually increasing inventory of wetlands, the goal does not imply that individual wetlands will in every instance be untouchable or that the "no net loss" standard should be applied on an individual permit basis—only that the nation's overall wetlands base reach equilibrium between losses and gains in the short run and increase in the long term. The public must share with the private sector the cost of restoring and creating wetlands to achieve this goal.

"No net loss" was subsequently adopted as a policy goal of both the Bush and Clinton administrations (White House, 1991; 1993). Vice-President Gore's Clean Water Action plan calls for achieving a net gain of 100,000 acres of wetlands by 2005 (Gore, 1997).

How do differing private and public incentives to preserve and convert wetlands translate into observed and optimal levels of wetland preservation and conversion? Is the "no net loss" goal consistent with an optimal allocation of wetlands between preservation and conversion? Figure 1 presents a stylized framework that helps us discuss the factors involved (Larson, 1994). The horizontal axis in each of the four diagrams represents the total initial stock of wetlands in the contiguous United States at the time of European settlement (221-224 million acres).[1] This initial stock has subsequently been allocated to one of two categories: remaining/protected wetland acreage P (measured from the left-hand side, about 124 million acres) and converted wetland acreage C (measured from the right-hand side, about 97 million acres). The vertical axis in each diagram represents an index of value, such as dollars per acre.

Figure 1-a represents the net marginal benefits individual landowners realize by protecting an incremental acre of wetlands (MB_p^i).[2] This curve is relatively low, since relatively few benefits of wetland protection exist that individual landowners can capture. Examples include private scenic, hunting and fishing, or recreational opportunities, and possibly economic returns from haying, grazing, or timber harvesting. MB_p^i would be expected to rise as the remaining acreage of protected wetlands decreases (moving from right to left).

Figure 1-b represents the net marginal benefit individual landowners realize by converting an incremental acre of wetlands (MB_c^i).[3] In contrast to individual benefits from wetland protection, MB_c^i may be relatively high, since conversion makes possible more intensive agricultural or developed uses that provide returns directly to the individual landowner. MB_c^i

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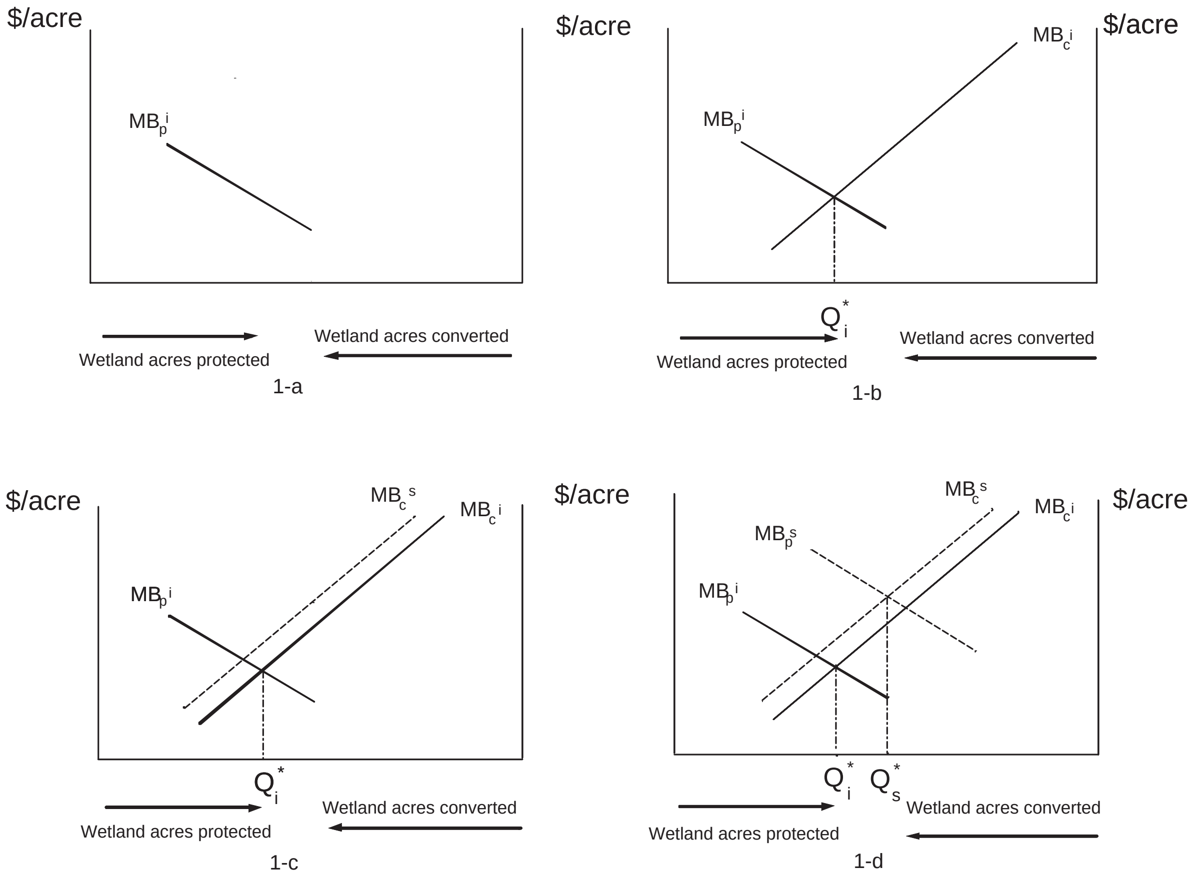
[1]This figure could also be constructed in terms of specific types of wetlands, such as prairie pothole wetlands or forested bottomland wetlands, or particular States or regions, such as Alaska or the Everglades. If functional assessment schemes such as the Wetland Evaluation Technique (WET; Adamus and Stockwell, 1983) or hydrogeomorphic (HGM; Brinson, 1993) rating methods could be agreed upon, the diagram could be couched in terms of wetland functions or services provided by remaining wetlands instead of acreage. The diagrams would be conceptually similar to those presented here for total wetland acreage.

[2]These are "net" benefits in the sense that they are adjusted for direct costs of wetland protection, such as monitoring and enforcement costs, but not for economic returns foregone, the indirect opportunity costs of not converting. Foregone economic returns are embodied in the marginal benefits to conversion, introduced next. Due to conceptual and measurement difficulties, the true level and shape of this curve is not known with precision. The same is true of the other curves introduced below.

[3]As with MB_p^i, these "net" benefits are adjusted for direct conversion costs, such as drainage costs, but not for indirect opportunity cost, such as the wetland benefits foregone. Foregone wetland benefits are embodied in the marginal benefits of protecting wetlands.

Figure 1

Optimal wetland conversion/protection



Source: Adapted from Larson (1994).

would be expected to decline as the acreage of converted wetland increases (moving from right to left). The privately optimal allocation of the stock of wetlands is represented by the point (Q_i^*) where the two marginal benefit curves cross. At this point, protecting an additional acre would cost more in terms of foregone benefits from conversion than would be gained in benefits from protection. Likewise, converting an additional acre would cost more in terms of foregone benefits from protection than would be gained in benefits from conversion. This simple framework can be extended to capture two important dimensions in wetland economics. First, we can use it to illustrate the differences between the public and private incentives to protect and convert wetlands. And second, we can use the resulting extension to illustrate changes in wetland policy and in conversion trends over the course of U.S. history.

Both conversion and protection generate public benefits as well as private benefits. In the case of wetland conversion, for example, these benefits may include increased agricultural output, lower consumer prices, and, in the 19th century, westward expansion and settlement. However, it is expected that public benefits to conversion are now small relative to private benefits since settlement has been accomplished and remaining wetlands are small relative to the cropland base. Adding these incremental public benefits to the individual benefits curve MB_c^i results in a social marginal benefit curve for conversion of MB_c^s in figure 1-c.

In the case of wetland protection, on the other hand, most benefits are public in nature. Examples include flood control, water quality improvement, fish and wildlife habitat, and recreational opportunities. Adding these public benefits to the individual marginal benefits curve MB_p^i results in the significantly higher social marginal benefit curve for protection of MB_p^s, as depicted in figure 1-d. The socially optimal allocation of the initial stock of wetlands (Q_s^*) thus occurs to the right of the privately optimal allocation

(Q_i^*), representing relatively more wetlands protected and less converted than under the privately optimal allocation.

Having distinguished public and private benefits from wetland conversion and protection, we can now use this graphical framework to characterize historic trends in wetland policy, conversion, and protection in the United States. The period from European settlement through the middle of the 20th century can be characterized as one in which the public benefits of wetland protection were not recognized. Even if benefits had been recognized, the initial stock of wetlands was sufficiently high that the marginal benefits of protecting the full initial stock were low. By contrast, the public benefits from conversion were recognized (in addition to the private benefits), and motivated the public incentives that were provided for wetland drainage and conversion. This set the country in motion towards an "optimum" allocation at the intersection of MB_p^i and MB_c^s, to the left of Q_i^* as depicted in figure1-c, representing a relatively high level of wetland conversion.

Over the course of the 20th century, as the public benefits of wetland protection came to be more fully appreciated, it became apparent that the socially optimal allocation of wetland resources lay further to the right, at Q_s^*(as depicted in figure 1-d at the intersection of social marginal benefit curves for preservation and conversion, MB_p^s and MB_c^s), representing a higher level of wetland protection. The various benefit curves may themselves shift over time. For example, increases in agricultural productivity over time shifted both MB_c^s and MB_c^i downwards as less land was required for a given level of production. These shifts also affect the optimal allocation of wetlands.

The problem in determining whether "no net loss" of wetlands is an appropriate policy goal in the United States today, or whether more wetlands or fewer wetlands would be socially superior, lies in the difficulty of determining how public benefits from wetlands change as more are converted (the location of the public marginal benefit curve, MB_p^s), and thus the optimal level of wetland resources remaining relative to the current allocation of the initial wetland stock (see Chapter II concerning wetland valuation). If we have already made it to Q_i^* or even farther to the left, then no net loss would be inadequate from a public policy perspective; a net *gain* of wetlands would be necessary to reach Q_s^*. If, in the course of historic wetland conversion, we have just made it to Q_s^*, then “no net loss” is an appropriate policy goal. On the other hand, if the current allocation still lies to the right of Q_s^*, some degree of net wetland loss would still be socially appropriate. Not surprisingly, given the difficulty in estimating public benefits and the different distributions of private costs that different wetland policies represent, there is considerable controversy over where the current allocation of wetlands lies relative to Q_s^*. The "no net loss" goal makes it clear that some think that enough (or even too many) acres of wetlands have been lost. Strong public support for wetland conservation validates this position.

Even in the absence of complete and accurate data about public benefits provided by wetlands, however, it is possible to estimate the level of public benefits required to justify "no net loss" in specific wetland contexts. Stavins (1990) develops theoretical models of privately optimal and socially optimal use of forested wetlands, and then links them in an econometric analysis of land-use data from 36 counties in the lower Mississippi alluvial plain during the period 1935-84. He then incorporates alternative estimates of environmental externality values (as indicators of public benefits) in a series of dynamic simulations to estimate changes in forested wetland acreage that would have occurred if private landowners had taken environmental consequences into account in their land-use decisions. Given historical levels of Federal construction and maintenance of flood-control and drainage projects, Stavins finds that $150 in annual environmental benefits per acre would have justified zero net depletion of forested wetlands in the lower Mississippi alluvial plain during this period. In the absence of such Federal projects, Stavins estimates that $80 in annual environmental benefits would have sufficed to make zero net depletion of wetlands optimal.

Stavins reports that benefits of such magnitude correspond to present values more than double the typical land prices in the study area. In terms of figure 1, the actual allocation of wetlands in the lower Mississippi alluvial plain (based on private optimization in the context of Federal flood-control and drainage projects) lies to the left of the socially optimal allocation (at Q_s^*). Stavins concludes that policymakers should consider ways of narrowing the gap between the actual and the socially optimal allocation of land between remaining and converted wetlands, including tax provisions, easements, and cross-compliance requirements.

Although Stavins' analysis indicates the type of estimation that can be done even in the absence of complete and accurate data about public benefits provided by wetlands, data constraints currently limit our ability to conduct a similar analysis on a national scale.

Wetland Economics and Technology

Benefits from wetlands are part of the equation, but costs for wetland drainage and wetland restoration enter into wetland economics as well by defining what conversion is physically possible. Drainage technology and drainage costs affect how far to the left (in terms of figure 1) we are able to encroach on remaining wetlands. Many of the major conversions undertaken in the 20th century, including those in South Florida and the Mississippi Delta, could not be undertaken until modern machinery and methods were developed.

The real cost of wetland drainage has declined unevenly over time, fluctuating from $225 per acre in 1900 to a low of $125 per acre in 1950. Costs rose to $210 per acre in 1970 and fell to $140 per acre by 1985. The real cost of subsurface drainage on farms was about $415 per acre in 1985, about half the cost of subsurface drainage in 1965. Significant technical advances that lowered the real cost of subsurface drainage include the development of continuous corrugated plastic tubing and improved installation equipment, notably laser beam grade control devices on trenching and other drainage equipment (Pavelis, 1987b). Further advances in drainage technology could make drainage profitable on additional wetlands, particularly in a period of high market prices, such as 1996. Some researchers speculate that wetland conversion has slowed in recent years in part because easily or cheaply converted wetlands have already been converted (Kramer and Shabman, 1993).

Beyond conservation, support for wetland restoration in such high-profile cases as restoring the natural course of Florida's Kissimmee River and efforts to rebuild vanishing Louisiana delta wetlands show that the public supports augmenting the remaining supply of wetlands. Although the public supports wetland restoration, some scientists are skeptical that these complex ecosystems can be rebuilt (Kusler and Kentula, 1990; Kentula, 1996; NRC, 1995). Success with wetland restoration varies from rapid and nearly complete in the case of resilient prairie pothole wetlands, through long-term and risky for bottomland hardwoods, to practically impossible for certain unique bog environments (NRC, 1992; Kentula, 1996).

Restoration costs and improvements in restoration technology play a part here in determining how far to the right of figure 1 the remaining stock of wetlands can be supplemented (King and Bohlen, 1994; King, 1992; NRC, 1992). For some wetlands, conversion is an irreversible decision not well reflected in figure 1. To the extent that restoration focuses on types that are relatively easy to restore and ignores or fails in more difficult situations, achieving "no net loss" of wetland acreage may mask changes to the mix of wetland types, and their unique functions and values, that comprise our stock of wetlands. Improving restoration technology for more difficult wetland types can lessen the need for conservation of these types because they can then be restored with some degree of certainty.

Policy Instruments To Equate Social and Private Incentives

Policymakers and society need to balance private rights to convert wetlands with public benefits from keeping wetlands intact (Kohn, 1994). For example, public policy can compensate a wetland owner to prevent converting a wetland and generating negative externalities. On the other hand, society can regulate conversion of wetlands to prevent damages to public interests in the wetland.

In fact, wetland policies are considerably more complex than these examples suggest, and thus far, there is no clear agreement between landowners and the public or consistency across public programs on which approach should prevail. At one end of the spectrum, Section 404 of the Clean Water Act regulates dredging and filling in wetlands (33 U.S.C. 1344). Section 404 implements the "no net loss" goal with a regulatory review process that handles small conversions through general permits, and conducts more thorough, qualitative reviews of the social costs and private benefits of major proposals affecting wetlands. The balance between private benefits and social costs is assessed for each permit. The Swampbuster provisions of the 1985 Food Security

Act (P.L. 99-198; 7 C.F.R. 12) deny most farm program benefits to farmers who choose to convert wetlands, but are not a regulation of wetlands, *per se*. Instead, Swampbuster provisions are a condition on continued receipt of payments from a voluntary program that reconciles society's interests in farm programs and in protecting wetlands. At the other end of the spectrum, the Natural Resources Conservation Service purchases interests in prior-converted (and subsequently restored and protected) wetlands from willing sellers through the Wetlands Reserve Program (P.L. 101-624; 7 C.F.R. 620).

Wetlands and Property Rights

Land ownership consists of a "bundle of rights," not all of which an individual landowner necessarily holds. Society generally reserves certain rights in each parcel of land, including the rights of eminent domain (the right to take property for public use, with compensation) and police power (the right to prevent actions that harm others). The appropriate balance between these rights and the rights of individual landowners is the subject of considerable debate, nowhere more vocal than in the case of wetlands, because it helps determine how wetlands are used and who benefits and loses from any use of wetlands (Kohn, 1994; Holtman, and others, 1996).

The rights of private landowners are protected by the Fifth Amendment to the Constitution, which states that private property shall not be taken for public use without just compensation. In addition, the Fourteenth Amendment states that no State shall deprive any person of property without due process of law. However, determining when property is "taken" has never been simple. Before 1922, the courts generally found takings to have occurred only when property was physically occupied for public purposes, such as constructing a road or school. Then, in 1922, the Supreme Court ruled that regulations restricting land use might constitute takings as well, if they went "too far" (Pennsylvania Coal Co. v. Mahon, 260 U.S. 393, 415-416). Just how far is "too far" has been debated ever since, although the courts have generally held that a landowner must suffer near-complete loss of the economic use of an entire property before a regulation is judged to be a taking (Michelman, 1988; McElfish, 1994).

The stringency of this test has meant that takings challenges are rarely successful in the courts. According to the Congressional Research Service, of 135 Federal takings cases between 1990 and 1994, only 21 were found to be takings (Meltz, 1995). The ratio is similar with respect to wetlands cases. As of May 31, 1993, only 28 cases involving takings claims had been filed with the U.S. Court of Federal Claims as a result of regulatory actions under the Clean Water Act's Section 404 permit program (USGAO, 1993). Ten of these cases were decided in favor of the Federal Government, 3 were determined to involve takings, 1 was settled before a decision was rendered, and 14 were still pending as of May 31, 1993. Since 1993, over 30 new takings cases have been filed against the Federal Government under the 404 program (Rugiel, 1996). Five additional cases have been decided to date, only one of which was found to involve a taking (Meltz, 1994, 1995, and 1997).

Advocates of property rights reform have been frustrated with the uncertainty of case-by-case takings determinations by the courts, and with the pace and outcomes of takings cases. Even the well-known U.S. Supreme Court decision in *Lucas v. South Carolina Coastal Council* did little to change the direction of Federal court decisions. In that 1992 case, the Supreme Court ruled in favor of a South Carolina developer who was prohibited from building on beach front property. South Carolina eventually compensated Lucas for the full value of his property, but the impact of that decision as a precedent was limited by the special circumstances of the case, including the complete diminution in property value that it involved (Sugameli, 1994).

Because of their frustration with the judicial system's treatment of the takings issue, advocates of property rights reform have pressed Congress for legislation requiring compensation whenever Federal actions diminish property values by more than a threshold percentage, particularly those actions restricting the conversion of wetlands and endangered species habitat (Hunt and VandenBerg, forthcoming). Such a proposal, passed by the House in 1995, faltered in the face of concerns about fiscal and environmental costs. Twenty States have enacted takings laws in recent years, but most require takings impact assessments rather than compensation (American Resources Information Network, 1997). Chapter V further discusses legislative action at the State level.