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A National Policy of "No Net Loss" of Wetlands

What Do Agricultural Economists Have to Contribute?

Ralph E. Heimlich (editor)

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A National Policy of "No Net Loss" of Wetlands: What Do Agricultural Economists Have to Contribute? Ralph E. Heimlich (editor). Resources and Technology Division, Economic Research Service, U.S. Department of Agriculture. Staff Report No. AGES 9149.

Abstract

Most wetlands lost recently were converted for agricultural production. President Bush proposed "no net loss" as a national goal, meaning that restoring wetlands must complement conserving wetlands to offset unavoidable losses. This symposium explored how "no net loss" might operate and the economist's role in developing this policy. Wetland policy evolution, costs of acquiring public rights to wetlands, valuing wetland benefits, and alternatives to existing institutional mechanisms for controlling wetland loss were discussed.

Keywords: Wetlands, policy, easement costs, restoration, values, incentives, regulation.

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Summary

This volume is based on a taped transcript of a symposium presented at the American Agricultural Economics Association meetings held at Vancouver, British Columbia, August 4-8, 1990. It contains an introduction and four papers by economists who have studied wetlands issues in academia and governmental contexts.

Wetlands constitute some of our most productive natural habitats and valuable wildlands. Of some 221 million acres of wetlands present in the continental United States in 1780, only 104 million acres remained in 1980. Annual losses are estimated at between 300,000 and 450,000 acres through the mid-1970's, but have probably slowed in the 1980's. Agriculture accounted for 87 percent of the 13.8 million acres of wetlands converted between the mid-1950's and mid-1970's.

There is a continuing evolution in Federal policy toward wetlands. Executive Order 11990, issued in 1977, ended a longstanding official policy of direct wetland conversion assistance. Indirect government incentives for wetland conversion, in the form of farm program benefits and income tax deductions, were largely eliminated by the so-called "Swampbuster" provision of the 1985 Food Security Act, and by changes in the 1986 Tax Reform Act. Undrained wetlands that are used for crop production are eligible for the Conservation Reserve Program, offering landowners an alternative to wetland conversion and the consequences of the Swampbuster provision.

This evolution does not appear to be stopping at elimination of direct and indirect incentives for wetland conversion. President Bush, in his 1990 budget message, called for "no net loss" of wetlands as a national goal, and an interagency task force is working to recommend means to accomplish this goal. The National Wetlands Policy Forum, convened by the Conservation Foundation at the request of the U.S. Environmental Protection Agency (EPA), recommended increased efforts at restoring altered wetlands to their natural state in pursuit of a long-term goal of increasing the quantity and quality of the Nation's wetland resource base. A wetlands restoration program was approved as part of the Food, Agriculture, Conservation, and Trade Act of 1990, omnibus farm legislation for the first half of the 1990's. The National Wetland Priority Conservation Plan, required by the Emergency Wetland Resources Act of 1986, and the North American Waterfowl Management Plan, jointly prepared by the United States and Canada, both call for increased acquisition and restoration of wetlands. Funding for wetland restoration projects is provided in The North American Wetlands Conservation Act (P.L. 101-224, 103 Stat. 1905 (1989)).

Economists have much to contribute to development of a national goal of "no net loss" of wetlands. In this volume, Jon Goldstein reviews the steps leading to the goal of no net loss. Ralph Heimlich traces wetland policy evolution, concluding that programs to restore wetlands in the 1990 Farm Act and the task force for no net loss are logical next steps. Peter Parks and Randall Kramer review normative and positive approaches to estimating costs of acquiring wetland easements. They find that estimating landowner participation in easement programs and participating acreage is more difficult than estimating wetland opportunity costs. John Bergstrom and Richard Brazee stress that economists need to extend site-specific benefit studies to regional evaluation models (REMS) for more general policy development. Local wetland benefit studies are still needed to help assess programs for conserving and restoring wetlands. Leonard Shabman suggests that economists' experience in designing institutions that rely upon financial incentives rather than command and control regulation can benefit wetland programs to achieve no net loss. He proposes wetland development fees based on development value, rather than wetland value, that could help rationalize the permit process and provide funding for wetland restoration. Questions from the audience and answers to them from the panel members complete the volume.

A National Policy of "No Net Loss" of Wetlands

What Do Agricultural Economists Have to Contribute?

Ralph E. Heimlich (editor)

Introduction

by Jon Goldstein*

This session addresses what economists can do to further the President's goal of no net loss of wetlands. The topics addressed by the speakers include: identifying the benefits associated with wetlands; evaluating nonmarket benefits; estimating the private opportunity costs associated with conservation and hence, how to design conservation programs that are best tailored to conserving wetlands; and an overview of the policy context governing the conservation effort. In brief, the speakers range widely, covering everything from how we got from the Swamplands Acts to the current national goal of no net loss.

I would like to give you a brief review of the recent events leading to the adoption of no net loss as a Presidential goal. In 1977, Jimmy Carter issued two executive orders: one on wetlands and one on floodplain conservation. These executive orders changed the focus of the Federal Government's efforts regarding wetlands. The executive orders directed all Federal agencies to minimize the effects of their activities on wetlands, and many agencies promulgated regulations and issued guidelines implementing the orders.

When the Reagan Administration came to power, it came with the conviction that the world was over-regulated, especially in the area of environmental matters. Initially within the Administration, consideration was given to rescinding the wetlands executive order. Ultimately, however, it was decided that rescission was politically untenable and that the best course of action was simply to ignore the order.

The issue of wetland conservation could not be avoided altogether, however. Ignoring regulatory responsibilities

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ultimately invites lawsuits and court-imposed solutions. And not making budgetary proposals for wetland acquisitions ultimately results in congressionally imposed purchasing requirements.

As Secretary of the Interior, James Watt had numerous wetland responsibilities. As an avowed conservative, he was suspicious of regulation and adamantly opposed to adding to Federal lands. He was, however, philosophically consistent, and as such was disdainful of subsidies. Thus, as an approach to conserving wetlands, he proposed relying on the method inherent in the Coastal Barrier Resources Act (CBRA): restrict or eliminate Federal programs that subsidize development in environmentally sensitive areas. Although Watt was unsuccessful in getting CBRA-like legislation enacted for wetlands, he planted the seed that resulted in a congressionally mandated study of the effects of Federal programs and subsidies on wetland loss and degradation (U.S. Department of the Interior, 1988).[1,2]

With the passing of the Watt/Gorsuch era and the ascension of Lee Thomas as Administrator of EPA, a more comprehensive approach was taken toward wetlands. Thomas had a genuine interest in wetlands. In 1987, he asked the Conservation Foundation to host a forum on wetlands policy, with participants from the business/agricultural community, conservation organizations, State and local governments, and relevant Federal agencies. As one of the staff to Interior's representative and an observer of the year-long deliberations, I thought nothing useful could possibly emerge from the diverse positions and partisan bickering.

So much for my predictive powers. The forum produced a consensus report, albeit with largely unrealistic recommendations (Conservation Foundation, 1988), a landmark, comprehensive examination of wetland issues (Leslie and others, 1990), and an appealing slogan, "No Net Loss of Wetlands." The officers at the Conservation Foundation are well connected, and soon "no net loss" was an integral part of campaign rhetoric. Raising cautionary eyebrows among his more fiscally bound advisors, President Bush reiterated the pledge of no net loss in his initial budget message to Congress, and set up a task force under the Domestic Policy Council (DPC), charged with identifying ways to strengthen the wetlands executive order and determining how best to implement the goal of no net loss.

Although the DPC task force is still deliberating, remarkable changes have already occurred in Federal policy. The principal agencies involved with wetlands (the Soil Conservation Service (SCS), EPA, the Corps of Engineers, and the Fish and Wildlife Service (FWS)) issued a manual in which they agreed to one method

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[1] Volume II is in draft and scheduled for transmittal by the end of 1991.

[2] Sources in parentheses cite authors listed in the References section at the end of this report.

for identifying and delineating wetlands (Federal Interagency Committee, 1989). Prior to this, all four agencies operated under different procedures for identifying wetlands. The manual has been controversial, inviting criticism from affected parties that it extended the regulatory jurisdiction without proper public notice and comment. Officially, the Administration has defended the manual as procedural clarification, but a court challenge has been filed and Members of Congress have shown concern and asked for explanations. This matter is likely to be revisited within the Administration.

In the fall of 1989, EPA and the Corps signed a memorandum of agreement specifying how wetland losses would be mitigated under the Clean Water Act's Section 404 regulatory program. The issuance of this document seemed to come as a surprise to many within the Administration. Its promulgation was delayed to allow interagency discussions. Following minor modification, it was issued in February.

The most important feature of the Memorandum is that it codifies the Council on Environmental Quality's definition of environmental mitigation (Code of Federal Regulations, part 1508.20(a-e)). Briefly: if an activity is not water-based, a permit for developing a wetland should not be issued. If the activity is water-based and in the public interest, mitigation on a function-for-function basis should be as complete as possible. For remaining wetland losses that cannot be mitigated on site, restoration elsewhere is in order.

The Policy Context

by Ralph E. Heimlich*

Wetlands are intrinsically important resources, typical of a class of resource problems increasingly confronting society. These are situations in which the resource provides public benefits in its natural state, but no benefit to the landowner unless it is developed. Other examples of these kinds of resources are coastal barrier islands, native remnant prairies, and old growth forests, including temperate and tropical rain forests. What is the appropriate role of resource policy in balancing losses of public goods against private gains from development of such resources? Tracing the evolution of government policy toward wetlands as a result of changing scientific and public perceptions of their importance is essential to understanding current wetland policy and probable future directions (Carey and others, 1990; Heimlich and others, 1989). It may be of greater interest as an indication of the kinds of accommodations that could be made for other such resources.

Perceived values of wetlands in North America have increased rapidly over the past two decades. Until recently, intrinsic values of wetlands were often perceived to be low compared with values from conversion of wetlands to other land uses. Since 1780, over half of the 221 million acres of continental U.S. wetlands originally present have been drained and converted to other land uses (Dahl, 1990). Agricultural uses accounted for an estimated 87 percent of the 13.8 million acres of wetlands converted between the mid-1950's and mid-1970's (Frayer and others, 1983). This translates into annual losses of 300,000 to 450,000 acres, although evidence suggests that the rate of wetland losses has declined in recent years (Office of Technology Assessment, 1984; U.S. Department of Agriculture, 1990).

Evolution of Wetland Policy

For the first 200 years of U.S. history, the Federal Government approved of and assisted with wetland drainage to further public health and economic development goals. Between 1849 and 1860, the Swampland Acts granted 64.9 million acres of wetlands to 15 States. Grants were made on the condition that proceeds of wetlands sold to individuals be used for reclamation projects. For the first 70 years of this century, the U.S. Department of Agriculture (USDA) had a policy of direct financial and technical assistance to the farm community for wetland drainage (Heimlich

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and Langner, 1986; U.S. Department of the Interior, 1988). Flood control, navigation, and highway projects also contributed to agricultural drainage by providing drainage outlets (Smith and Massey, 1987; Kramer and Shabman, 1986). While Federal aid was not solely responsible for wetland drainage, it did provide positive economic incentives. Most direct incentives ended in the 1970's for a variety of reasons, culminating in Executive Order 11990 issued in 1977. This ordered agencies of the Federal Government to "minimize the destruction, loss or degradation of wetlands" and to "avoid direct and indirect support of new construction in wetlands wherever there is a practicable alternative." Indirect Federal assistance for wetland conversion was eliminated by the so-called "Swampbuster" provision (Title XII C, P.L. 99-198) of the Food Security Act of 1985, and by changes in the 1986 Tax Reform Act (Heimlich and Langner, 1986; U.S. Department of the Interior, 1988; Ward and others, 1989). The Swampbuster provision made a farm operator ineligible for price support payments, farm storage facility loans, crop insurance, disaster payments, and insured or guaranteed loans for any year in which an annual crop was planted on converted wetlands. Tax reform restricted or eliminated many provisions that indirectly subsidized agricultural wetland conversion. Among these were deductions for land-clearing expenses, deductions for soil and water conservation expenses, and preferential treatment of capital gains, including capital gains realized from draining wetlands.

While agricultural policy was evolving, we did have some policy initiatives that were designed to conserve wetlands on private lands. USDA's Water Bank program was authorized in 1970 and amended a decade later (PL 91-559; PL 96-182). In return for annual per-acre payments, landowners agree not to burn, drain, fill, or otherwise destroy the character of enrolled wetland areas. Focused on the Northern Plains, as of March 1989, the program contracted 4,366 agreements covering 493,000 acres (Agricultural Stabilization and Conservation Service, 1988). Only one-third of the land under Water Bank agreements is wetland, while the remaining two-thirds is adjacent upland area on which agricultural use is restricted. In 1982, renewal rates for the first group of contracts were between 50 and 60 percent (Office of Technology Assessment, 1984). The low rate provides evidence that landowners in the past had enrolled wetlands when commodity prices were depressed, only to withdraw them again when markets were strong. The 1990 budget allowance for the Water Bank program included a request for $8.4 million, allowing enrollment of 160,000 acres of wetland and 350,000 acres of upland (U.S. Department of the Interior, 1988).

In 1989, Conservation Reserve Program (CRP) eligibility was expanded to include wetland that had been cropped for at least 2 years between 1981 and 1985, but had not been drained (Federal Register, 1989). Some 410,000 acres were enrolled in the eighth and ninth signups, most in the Prairie Pothole region of North Dakota, South Dakota, and Minnesota (Osborn and others, 1990). The Fish and Wildlife Service's Small Wetland Acquisition Program (SWAP) paid for leases, easements, and fee-simple purchases of

wetlands. Permanent easements on 125,682 acres of wetlands and adjacent areas were included in National Waterfowl Production Areas and refuges between 1981 and 1988 (Migratory Bird Conservation Commission, 1988).

Wetland Regulation

There is a separate regulatory track to wetland policy, which evolved to deal primarily with tidal and estuarine wetlands. Section 404 of the 1972 Federal Water Pollution Control Act amendments established a dredge-and-fill permit system. The Army Corps of Engineers administers Section 404 with oversight by the EPA. Section 404 permits are justified under the legal authority to limit discharge of dredge-and-fill material into navigable waters. This justification is derived from a long-recognized Federal jurisdiction over navigation.

Drainage is excluded from Section 404 requirements. In the past, Section 404 has not affected agriculture to any extent because most onfarm conversion involves drainage rather than dredge and fill (U.S. General Accounting Office, 1988). In addition, "normal agricultural and silvicultural practices," such as maintenance of drainage ditches and levees, have been exempt from Section 404 permit requirements. Exclusion of agricultural wetland conversion ended in 1989.

Before 1989, the Corps did not consider areas previously converted for crop production as wetlands subject to permit requirements. However, faced with concerns over differing wetland definitions, the four agencies of the Federal Government with primary wetland responsibilities (Corps, EPA, FWS, and USDA) adopted a standard wetland delineation manual in January 1989. The manual uses the more encompassing Swampbuster definition of wetlands, based on hydric soils capable of supporting hydrophytic vegetation (Federal Interagency Committee, 1989).

Section 404 regulations still exempt most routine agricultural practices, and a September 9 regulatory guidance letter further exempted farmland converted prior to 1985, consistent with the scope of USDA's Swampbuster program. Nevertheless, changes in levees, dikes, and drainage on a larger amount of farmland still classified as wetlands and previously ignored now come under Section 404's purview. Controversies over what activity requires a permit and what will be permitted have been largely resolved. Most normal agricultural activities will be allowed to continue under 404 scrutiny. The more fundamental issue of what is and is not a wetland will continue to be debated.

The Road to "No Net Loss"

How did we get to a goal of no net loss? The origin goes back to the Fish and Wildlife Service's mission to protect waterfowl and certain private initiatives, such as Ducks Unlimited work to conserve and restore waterfowl habitat. As early as 1954, FWS

associated waterfowl conservation with wetland habitat (Shaw and Fredine, 1956). The National Wetland Priority Conservation Plan, required under the Emergency Wetland Resources Act of 1986 (PL 99-645), emphasizes conserving and restoring wetlands (Fish and Wildlife Service, 1989). The North American Waterfowl Management Plan, a joint agreement and treaty between the United States and Canada, also calls for restoring former waterfowl habitat. The North American Wetlands Conservation Act (P.L. 101-224, 103 Stat. 1905 (1989)) establishes a Wetland Trust Fund, authorizes appropriations of $15 million annually over 1991-94, and establishes the North American Wetlands Conservation Council to approve wetland restoration projects.

Another step on the road toward the goal of no net loss occurred in North Dakota. The Garrison Diversion project was the subject of a compromise between the State of North Dakota, the Corps, and environmental groups that had been delaying the project. These parties agreed to a reduced project if North Dakota, among other conditions, adopted a program of no net loss of wetlands (Sambor and others, 1989).

As Jon[3] mentioned, the direct antecedent of no net loss at the Federal level was the National Wetland Policy Forum. The Forum recommended a policy of no net loss of wetlands. Quoting from their report:

> "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." (Conservation Foundation 1988, p. 3)

President Bush endorsed the goal of no net loss during his presidential campaign. In an address to the Ducks Unlimited Sixth International Waterfowl Symposium, the President said:

> "Wherever wetlands **must** give way to farming or development, they will be replaced or expanded elsewhere. It is time to stand the history of wetlands destruction on its head."

In his 1990 budget message to Congress, the President referred to the goal of no net loss. He established a task force under the White House Domestic Policy Council to determine how the goal could be achieved. Activities of the task force have been few to

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[3] Jon Goldstein, preceding paper in this collection.

date. However, several regional public hearings on the goal of no net loss were conducted in August and September 1990 (Federal Register, 1990). Plans include revision of Executive Order 11990 to implement the goal of no net loss.

Agriculture and "No Net Loss"

Probably the most significant wetland policy changes that will affect agriculture are conservation provisions in 1990 omnibus farm legislation. The 1985 Food Security Act included the Swampbuster provisions and the CRP, later expanded to include cropped wetlands. In the Food, Agriculture, Conservation, and Trade Act of 1990 (FACTA), Congress has gone even further with three major provisions that affect wetlands.

First, an agricultural wetland reserve program is established as part of the Environmental Conservation Acreage Reserve Program (Section 1438). The Act calls for restoration of 1 million acres of cropland to wetlands. The program requires permanent or long-term easements with the landowner to restrict agricultural use of restored wetland. Eligibility extends to existing cropped wetlands, restorable wetlands, other non-cropped wetlands (such as Water Bank lands), riparian corridors, and critical wildlife habitat. Adjacent cropland that may be used as a buffer zone or is functionally related to the restored wetland is also eligible.

Economic uses of the restored wetlands can be included in the restoration plan that will help reduce the cost of acquiring easements, if those uses are not incompatible with the basic objective of preserving the wetland.

Costs of such a reserve are to include the easement value, which cannot exceed the market value of the land, and restoration cost sharing for the actual restoration of up to 100 percent for permanent easements. These provisions, rather than treating agriculture in a regulatory fashion, offer incentives to restore and conserve wetlands.

Long-term or permanent easements on restored wetlands are also allowed as changes in conservation uses under the Conservation Reserve Program (Section 1435), in the Environmental Easement Program to permanently protect wetlands restored previously in the CRP (Section 1440), and in watershed and flood prevention projects (Section 1462). Wetland protection is also encouraged in the Agricultural Water Quality Protection Program (Section 1439).

Analysts have estimated the costs of such agricultural wetland reserves (Heimlich, 1990; Carey and others, 1990). The lowest total cost for a 1-million-acre restoration program is estimated to be $194-$286 million. Of that total cost, $105-$197 million (54-69 percent) would be for easements and the remainder for wetlands restoration. The cost of the last acre included in each

reserve size (marginal cost) ranges from $310-$581 per acre. Easement costs are based on estimated net returns from crop production, reflecting the opportunity cost of idling the cropland.

The second set of wetland policy changes in the 1990 FACTA made important changes to the Swampbuster provision (Section 1421). One change closes a loophole in the Swampbuster provision. Previously, producers who converted a wetland and planted an agricultural commodity lost farm program benefits on their entire operation. However, eligibility for benefits was restored if no crop requiring annual tillage was planted the following year, despite wetland destruction. The 1990 FACTA expands the Swampbuster "trigger" to include conversion of a wetland to make production possible. Converting a wetland to make production possible will invoke loss of benefits, and benefits cannot be restored until the converted wetland is restored.

In return, commodity interests obtained some concessions on Swampbuster. The minimal effect clause, which exempts conversions that are determined to have minimal effect on the hydrological and biological properties of the wetland, has been expanded to allow mitigation (Section 1422 (f)). Mitigation is the term used in Section 404 for wetland restoration or creation to replace wetlands lost to development. This compromise comes despite the reservations many environmentalists have about our ability to restore, but especially to create, wetlands (Steinhart, 1987). In the changes to Swampbuster, a farmer can drain a wetland without losing farm program benefits if another prior converted wetland somewhere else on the farm or in the local area is restored.

Farm groups also convinced Congress to change the so-called "drop dead" penalty in the Swampbuster provision (Section 1422(h)). The previous penalty meant loss of all farm program benefits for small wetland conversions. The new graduated penalty provision allows an operator to violate Swampbuster once in 10 years if the wetland is restored and if the conversion occurred in good faith. The penalty ranges from $750 to $10,000, depending on the severity of wetland destruction. While substantial, these fines are less than farm program benefits which may run to several hundred thousand dollars. The operator remains ineligible for farm program benefits until the converted wetland is either restored or mitigated.

The last major provision in the 1990 FACTA dealing with wetlands clarifies the Farmers Home Administration (FmHA) easement program. FmHA, acting under the authority of Executive Order 11990, had required easements on all wetlands on property that came into FmHA's land inventory through loan default. If a farmer defaulted on a loan and the property went into FmHA's inventory, FmHA cooperated with the Fish and Wildlife Service to identify wetlands and place easements on them before the property could be resold. Such easements were in conflict with provisions of the 1987 Farm Credit Act. Under this Act, FmHA borrowers

could redeem loans in default and regain control of the property in its condition when default occurred. In the 1990 bill, FmHA can still require easements on all noncropped wetlands, but the acreage of cropped wetlands and prior converted wetlands subject to easements is restricted.

Congress clearly intends to refine and expand wetland conservation and restoration programs associated with farming, first introduced in the 1985 Food Security Act (Congressional Record). There has been little backsliding on agricultural wetland provisions in the 1990 FACTA.

Issues for a "No-Net-Loss" Policy

"No net loss" of wetlands means restricting landowners' property rights to protect a continued stream of public goods from the resources. The fundamental issue raised by a policy of no net loss, both for wetlands and the other similar resource problems, is the appropriate balance between the regulatory and compensatory measures. The public believes fundamental property rights are important and also values the public goods produced by natural resources in private ownership. We need to balance these conflicting values and choose between, or combine, regulation and compensation to achieve that balance. Historically, Congress created financial incentives in agricultural programs to compensate landowners for changes in the bundle of property rights that farmers can exercise on their land. Some view the Swampbuster provision as regulatory. In fact, it is a condition on receipt of benefits in a voluntary program, albeit one that many farmers view as necessary to their economic survival. Except for the Swampbuster provision, the 1990 FACTA continues the historical pattern of economic incentives for desired environmental behavior.

A second issue concerns the adequacy of the supply of wetlands, a particularly cogent issue for economists. We do not have firm estimates of either the economic demand that the public expresses for wetland functions and services or the biological needs for wetland acreage to support important ecosystems. It is clear that a large segment of the public thinks there are too little wetlands because the issue has been repeatedly raised and policymakers are paying attention to the issue. However, simple concern over resource adequacy is not a sufficient basis for making public policy.

Finally, there is the issue of conservation versus restoration. Should we put relatively more effort into conserving our existing wetland resources than restoring wetlands that have previously been converted? On a pure efficiency basis, does not conservation avoid adding the cost of restoration on top of the original costs of converting the wetland? The answer inherent in the National Wetland Policy Forum's and the President's statements about no net loss is that conservation will not be enough. There are going to be unavoidable wetlands losses for

overriding public purposes. Then, the question is: How do we make up for those unavoidable losses? The only way is some form of a wetland restoration or creation program.

Costs of Wetlands Protection and Restoration Policies: Positive and Normative Approaches

by Peter J. Parks and Randall A. Kramer*

Loss of environmental benefits due to wetlands conversion has concentrated attention on policies to protect or restore wetlands. Sustaining the environmental benefits provided by wetlands provides an opportunity for interaction between environmental and agricultural policies (Just and Antle, 1990). Although new incentives for protecting existing wetlands and restoring cropped wetlands are imminent, little has been done to evaluate the costs and benefits of alternative programs.

The recent Conservation Reserve Program shows that environmental goals can be achieved by subsidizing changes in marginal agricultural land use. This program changed the use of 33.9 million acres of highly-erodible agricultural land (85 percent of the 40-million-acre target) at a total rental cost of $1.7 billion (Osborn and others, 1990). Continued congressional commitment to environmental and conservation programs related to agriculture is evident in the 1990 Farm Act. However, the potential effectiveness of programs for establishing wetland reserves remains unknown.

The Cost of Wetlands Protection and Restoration Policies

As Ralph[4] detailed, several programs are designed to protect and restore wetlands. Federal examples include the Swampbuster provision of the 1985 Food Security Act, the Small Wetlands Acquisition Program, the Water Bank Program, Section 404 of the 1972 Clean Water Act, and the Conservation Reserve Program. Tax reform and water resource development projects may also affect wetlands conversion (Kramer and Shabman, 1986; Stavins and Jaffe, 1990).

To be economically efficient, protection and restoration policies should balance the costs and benefits of wetlands reserves. Benefits can consist of both market (for example, crab fisheries) or nonmarket (for example, waterfowl habitat) elements. Costs include direct costs (such as restoration costs) and opportunity costs (such as forgone crop income). Costs of establishing wetlands reserves can be calculated using normative and positive approaches. Normative land studies specify behavioral objectives, such as maximizing net revenue, and calculate land allocations consistent with these objectives. In contrast,

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[4] Ralph Heimlich, preceding paper in this collection.

positive land studies statistically quantify the degree to which land allocations are consistent with behavioral hypotheses. Both normative (Heimlich and others, 1989) and positive (Stavins and Jaffe, 1990) studies can be used to calculate economic conditions required to obtain specific land use allocations.

This section summarizes normative and positive economic studies relevant to wetlands conversion that may be potentially useful in designing or evaluating wetlands policies. These studies are then discussed in the context of an abstract model of wetlands conversion, protection, and restoration decisions. The objectives are to provide a framework within which to place existing studies of wetlands and to identify future research needs.

Normative Approaches

Normative models of wetlands conversion and restoration describe the allocation of scarce land resources to optimize an objective, such as net revenue. Land resources are typically divided into productivity classes, and empirical values are assigned to the parameters in linear or quadratic profit functions. Mathematical programming methods are then used to calculate the impact of changes of such parameters as commodity prices on optimal land allocations. Sensitivity analysis then determines the most crucial parameters affecting conversion of wetlands to agriculture or to wetlands reserves.

Normative studies can clarify agricultural land optimization and opportunity costs as they relate to wetlands conversion, protection, and restoration. For example, regional studies by Danielson and others, and Kramer and Shabman examine conversion by calculating net returns, including clearing and draining costs. The profit functions used in these studies differ. For example, some include price and income supports (Danielson and Leitch, 1986; Danielson and others, 1988; Danielson and Hamilton, 1989; Heimlich and others, 1989, and Kramer and Shabman, 1986) or Federal taxes (Danielson and Leitch, 1986; Danielson and others, 1988; Danielson and Hamilton, 1989; and Kramer and Shabman, 1986). Others allow for stochastic crop yields (Kramer and Shabman, 1986) and conversion to silviculture (Kramer and Shabman, 1986; Danielson and Hamilton, 1989). The per acre net present value of converting wetlands to agricultural land use ranges from $151 for the Mississippi Delta region (Kramer and Shabman, 1986) to $637 in North Carolina (Danielson and others, 1988; Danielson and Hamilton, 1989) and $257 in central Minnesota (Danielson and Leitch, 1986). These benefits must be forgone if lands are to be devoted to wetlands reserves. These are estimates of the payments required to protect existing wetlands. Heimlich and others add a wetland restoration activity, and apply the approach at a national level to calculate the costs of 1-, 2.5-, 5-, and 10-million-acre wetlands reserves (Heimlich, 1990; Carey and others, 1990).

Normative models can identify crucial components of land allocation decisions through sensitivity analysis. A further advantage is that these models are often less data-demanding than positive models, and are frequently developed using cross-section data alone. Some profit function components, such as restoration costs, can potentially be affected by policies to achieve desired land allocations. In addition, by providing estimates of conversion benefits, all these studies can potentially be used to calculate net opportunity costs of protection. To date, Heimlich and others is the only normative study specifically designed to calculate policy costs, and is one of the few that includes a restoration activity.

Positive Approaches

Positive models relevant to wetlands reflect two key choices associated with land policies: (1) discrete choices to participate in programs; and (2) continuous choices of acres to enroll. Land policy instruments, such as subsidies, affect individual participation decisions, while policy success, measured as wetland benefits provided, depends on the areal extent of participation. The relationship between policy instruments and measurement of policy goals suggests three categories for positive models. These include analysis of program participation (Esseks and Kraft, 1988), analysis of acreage enrolled (Konyar and Osborn, 1989), and simultaneous estimation of both participation and acreage (Hardie and Parks, 1991).

Few positive studies specifically examine wetlands; thus, studies of CRP participation and acreage are relevant for several reasons. For both erosion reduction and wetlands restoration, an economic decision is made to forgo the use of environmentally sensitive lands for agricultural purposes. The opportunity cost of retiring both erodible lands and wetlands consists of crop net returns and farm program payments. In addition, although most of the CRP practices are designed to reduce erosion, the ninth signup includes a wetland restoration activity (Conservation Practice 14). For these reasons, studies of CRP and acreage enrollment are included in this section (Esseks and Kraft, 1988; Konyar and Osborn, 1989).

Acreage models are capable of providing cost estimates for wetland reserves by calculating economic conditions required to obtain desired acreages. For example, the Stavins and Jaffe model estimates that zero net depletion of bottomland hardwood wetlands from 1935 to 1984 would have been optimal for annual values of wetlands services in the range of $80-$150 per acre (Stavins, 1989). These values could be considered lease payments required to establish a reserve at 1935 levels of wetland acreage; the cost could be calculated by multiplication. Other than Stavins and Jaffe, few positive acreage studies specifically examine wetlands. Konyar and Osborn (1989) relate the regional CRP enrollment (in signups 1 through 8) to farm size, land value, average age of owners, land tenure, erosion rate, and expected

net return. Lease payments are subsumed in expected net returns, so that payments are not directly linked to acreage, requiring a minor change in specification. Research in progress using CRP data, noted below, will include wetlands restoration, and separate measures of payments as explanatory variables. This will allow enrollment levels and program lease costs to be explicitly linked.

No studies of participation in existing wetlands protection or restoration programs were found. However, Esseks and Kraft present a relevant participation model based on survey data for midwestern farmers. Their specification quantifies the influence of age, education, product value, erosion rate, and percentage of income from crops on the decision to participate in signups 1 through 4 of the CRP. The results show that product value, hence opportunity cost, significantly affects this decision. Acreage enrolled was not studied, making it difficult to calculate costs of achieving acreage allocations without resorting to ownership size assumptions. Although not a participation model, Ligon and others summarize survey data that suggest that farm size, familiarity with programs, and desire for land use flexibility may also be important in CRP participation in the Chesapeake Bay area. Simulating the costs required to obtain different acreages is possible, if the costs are integrated with acreage enrollment models (Hardie and Parks, 1991). Research examining participation in a hypothetical wetlands reserve program in North Carolina will be presented below. The study employs contingent valuation survey methods to link potential lease and easement payments to wetlands protection and restoration.

To obtain parameter estimates, participation models frequently use cross-section survey data on hypothetical or actual owner decisions. Acreage models use both time-series and cross-section data. Regional discrete-continuous models require area-frame data. The cost of accomplishing land-use goals requires calculating the conditions required for levels of participation and acreage enrollment from estimated models. One advantage to this approach is that it can quantify actual, rather than hypothetical, behavior.

Research in Progress

We have two research studies in progress that are designed to meet some of the information needs described above. The first study is based on farm-level survey data for a single county, the other is based on secondary, cross-sectional, county-level data. The farm-level research is a positive analysis of participation in a hypothetical wetland reserve program in North Carolina (Ramsey, 1990). In April 1990, a mail survey was sent to farm operators in Bladen County, North Carolina. These owners were selected after aerial photographs had been used to identify Carolina Bay wetlands within ownership boundaries. Carolina Bays are elliptical depressions found primarily in southeastern North Carolina and eastern South Carolina (Sharitz and Gibbons, 1982).

Most are saturated in the spring and dry by the fall. Many have been converted to agricultural uses.

The survey used contingent valuation methods to assess operator willingness to supply lands for a hypothetical wetlands reserve when confronted with various bid levels. These methods have been used primarily to estimate the demand for environmental amenities. However, contingent valuation is also potentially useful as a means of estimating farmers' willingness to supply wetlands, conservation, and other environmental goods. This approach is particularly useful for analyzing new or potential programs because various contingencies can be described to respondents and their responses gauged. Purvis and others have reported success in using this approach to determine potential response to a filter strip program in Michigan.

Two hypothetical markets were described to nearly 200 Bladen County farmers. One was for a protection program for existing wetlands, with either a 10-year lease or permanent easement. The other hypothetical market was for a restoration program for previously converted wetlands, again with either a 10-year lease or a permanent easement.

As expected, operators would be willing to enroll a larger proportion of their wetland acreage as the offered payment level increases. Also, the results show that opportunity costs are a driving factor in willingness to enroll. The less frequently the farm's wetlands flood, the less acreage operators are willing to enroll. If corn is produced on the farm, there is less willingness to enroll in the wetland reserve. Corn is the predominant crop in the county. Its negative effect on willingness to enroll reflects the opportunity cost associated with permanently giving up future cropping opportunities.

The second study underway will use existing data on enrollment in the CRP wetlands restoration practice to develop a national participation model (Parks and Kramer, 1990). Enrollment responses employing Conservation Practice 14 in counties with large wetlands acreages will be correlated with bid levels, opportunity cost measures, and various socioeconomic characteristics to estimate a participation equation. These data may be pooled with other enrollment practices, if statistically appropriate. The participation equation will form the key component of a simulation model for predicting program enrollments. Using geographically specific data on wetlands type and location, constraints will be constructed to allow simulations of enrollment under various conditions. For example, the effects of different subsidy levels on enrolled acreage in each region will be tested. Similarly, the model will be used to analyze the effects of alternative regional targeting rules. This study is at the early stages of data gathering and model specification.

Conclusions

There are a number of opportunities for further research in both normative and positive analyses of costs of wetlands protection and restoration policies. Heimlich and others is the only study specifically designed to examine wetlands policy costs; however, the optimization is static, and owners are presumed risk-neutral. This approach could be extended to consider price feedback effects, as well as alternative risk preferences. Positive studies of wetlands policy costs are scarce. Research is needed to study participation and acreage decisions. Stavins and Jaffe examine wetlands acreage, but not specifically for the purpose of evaluating the costs of reserves.

Heterogeneity of land and of owners must be considered in analyzing new wetlands policies. Stavins and Jaffe provide insight into how to accommodate unobservable land quality differences in a regional model. Participation models, as well as anecdotal evidence, suggest that heterogeneity of owners is a statistically significant influence on the decision to participate in set-aside programs (Esseks and Kraft, 1988; Ligon and others, 1988). Integrated approaches that account for both land and owner differences may be successful (Hardie and Parks, 1991).

Benefit Estimation

by John Bergstrom and Richard Brazee*

> "The top farm issue today is wetlands, more so than the general farm bill. Pressures mount for fast relief. Up to 60 million acres of cropland can be lost unless changes are made in the wetlands delineation manual. A word from President Bush would help. It will be extremely difficult to get the job done administratively unless Bush tells the bureaucrats that present regulations are more restrictive than what he had in mind when he said 'no net loss' of wetlands. The head of Fish and Wildlife Service says his goal is to return 20 million acres now in crops to wetland status. So far, USDA has been quiet on wetlands, simply standing aside. Some farm leaders say it is simply 'ducking' the issue." (Kiplinger Agriculture Newsletter, April 6, 1990)

As the above quote suggests, the proposed policy of no net loss is controversial. In order to resolve conflicts and concerns related to the policy, reliable and relevant wetland valuation techniques need to be developed and applied.

Valuation Tasks

Wetland valuation first requires that a definition of no net loss be developed that is consistent with economic theory and valuation techniques. A one-to-one physical tradeoff definition is probably no good since all wetland acres are not alike. Wetland acres differ in their ability to produce services that are useful to people and wildlife. Following up on Peter and Randy's paper[5] on costs of wetland restoration, Dick Brazee and I came up with a definition that equates the net present value of wetlands lost to the net present value of wetlands gained. In applying this criterion, the overall need is to develop techniques for estimating the economic value of wetland services which account for complex bioeconomic linkages. The problem is how to identify and quantify these bioeconomic linkages.

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[5] Peter Parks and Randall Kramer, preceding paper in this collection.

Table 1 illustrates some of the fundamental bioeconomic linkages related to wetlands. We start out with a wetland that generates a function. For instance, it might be a physical medium for tree growth that supports a service, such as commercial tree harvest. That service has an economic value, in this case the net value of the timber. Dick Brazee, who is a forest economist, tells me that foresters can model and value these linkages fairly well. Foresters can examine a wetland acre and determine the type of tree that will grow there and the associated board-feet of timber that can be produced. Next, going from the service to the value, forest economists have market valuation techniques that consider commercial prices of timber, transportation costs, production costs, and other factors to estimate the net economic value of the timber produced.

Table 1--Wetlands bioeconomic linkages

	Example		
Wetland	Forestry	Fisheries	Recreation
Function	Tree habitat	Fish habitat	Wildlife habitat
Service	Commercial timber harvest	Commercial fish harvest	Recreational waterfowl harvest
Value	Net economic value of timber	Net economic value of commercial fish	Net economic value of hunting success

In the example of commercial fishing, the linkages get a bit more fuzzy, particularly the relationship between fish habitat and commercial fish harvest. A wetland area functions as a nursery ground for young fish, and as a medium for further growth. The tonnage of fish and shellfish that can be harvested in an estuary, or offshore from the estuary, is related to this wetland habitat function. The economic value linkage is the relationship of the commercial fish harvest to the net value of the commercial fish species. That is, once the tonnage harvested is known, an economist can combine dock prices with estimates of production and harvesting costs to estimate the net economic value of the harvest.

Finally, the linkages that may be the fuzziest of all are those involving nonmarket valuation. For example, the wetland function could be wildlife habitat that provides a service of recreational waterfowl hunting. Estimating the relationship between wildlife habitat and waterfowl bag (the number of waterfowl shot) is an extremely complicated process. The economic valuation linkage is the relationship between recreational waterfowl bag and the net

economic value of hunting success. Nonmarket valuation techniques such as the contingent valuation method, the travel cost method, or hedonic pricing can be used to establish the linkage between the service and wetland values. The relationships between wildlife, wildlife populations, waterfowl bag, and economic values involves biological, recreational, sociological, and economic considerations.

The practical problem with respect to the goal of no net loss is to find a way of evaluating these linkages that is timely and can be used by resource management agencies in the field. To actually implement a policy of no net loss, we have to develop techniques that are not going to be excessively time-consuming and expensive. Thus far, economists have worked mostly on an individual, case-by-case, site-specific basis. These site-specific studies usually involve intensive efforts to collect primary data (for example, Bergstrom and others, 1990).

A more systematic valuation approach, which has been proposed in the past and is getting more attention recently, is development of regional value estimator models. These are models that can be used to simulate linkages between wetland characteristics, functions, services, and values. Once developed, these models could be applied to different areas with a minimal amount of primary data collection.

The problem is how to estimate such models. There are two basic approaches. One approach is what Dick and I call the "megamodel" approach. This would involve assembling a research team to incorporate all of the bioeconomic linkages into some "megamodel" (Ward and Isytar, 1990). The other approach, which we favor, is a "division of labor" approach that takes advantage of specialization. This approach resembles a subcontracting system, where some of the biological linkages between functions and services might be handled by biologists and other specialists, and the linkages between services and values could be handled by economists.

What is the main problem with subcontracting? Anyone who's built a house or the Hubble Space telescope knows about subcontracting problems. The problem is quality control associated with farming out pieces of a large puzzle or project. The pieces you get back may not fit together into a coherent, working whole.

Role of Economists

The particular subject of this symposium is the role economists might play in the issue of no net loss. One function that economists might play is coordinating the overall valuation-modeling effort, acting as the model-building contractor or coordinator. Economists should not try to do everything, but could act as coordinators to ensure quality control. Economists, however, may not have enough background in the physical sciences to be able to communicate and model effectively. Economics

graduate programs, even in forestry graduate programs where there has been more of a tradition of physical science training, are moving more and more toward training solely in economics.

Another concern is agency interaction. Which agency should take the lead in coordinating valuation model development? What sort of cooperation would have to be developed between agencies on funding and other management issues? How would the academic community be involved in the process?

A more technical role for economists is that of developing the economic valuation models that link values to services. For instance, John Stoll and I worked on developing a model for Louisiana wetlands that linked willingness to pay for wetlands-based recreation to changes in recreational fish catch, waterfowl bag, and nonconsumptive aspects of recreational trips (such as enjoyment of esthetic scenery) that would be affected by changes in wetlands and wetland functions (Bergstrom and others, 1990). We modeled just that one piece of the puzzle (that is, the linkage between services and values) and left the linkage between functions and services to the biologists. We provided U.S. Army Corps of Engineers biologists with a model that links services to values, but it is not really completely useful to them until they come up with a model that links wetland functions to wetland services, such as waterfowl bag.

Valuation Model Estimation Concerns

In developing our valuation model, Stoll and I ran into a number of problems and concerns. First, estimation of value estimator models is very data intensive (our study included over 4,000 observations). Another concern is complex econometric estimation problems and issues. There are also difficulties with model validation. What is "truth"? How do we validate these models when we lack an objective standard of comparison?

The effect of relative scarcity is another concern. Economists know that the value of a commodity will be different according to how much of it exists. The same wetland acre that generates the same amount of services will have a different value in different regions, according to how scarce similar wetlands are in that region. How do we adjust a model developed in one region for a different relative scarcity of wetlands in another region?

A further concern is the effect of valuation sequence on the estimated values of policies and programs. For example, suppose we want to value the different benefits of wetlands for such services as hurricane protection, groundwater recharge, and recreation. Economic theory and empirical work suggest that the order in which we ask respondents to value these benefits (for example, in a contingent valuation exercise) will affect the value measured for each individual component (Bergstrom and Stoll, 1987; Hoehn, 1989; Hoehn and Randall, 1989). Information effects are also a concern, particularly with nonmarket valuation methods, such as contingent valuation. How

much information do respondents need to value wetlands benefits accurately, particularly for complex bioeconomic linkages? If physical scientists studying these relationships barely understand them, how can we expect the lay person to appreciate them without providing them with additional information?

Finally, the level of wetland services desired involves equity considerations. This relates to enshrining the current level of wetlands. The concept of no net loss implies something about the current level of wetlands, but what is so special about that level? Would society want to set a higher or lower goal? This is ultimately a subjective equity question which needs more thought and debate.

Integrating Agricultural Reconversion of Wetlands into Achieving Environmental Goals in Urbanizing Regions

by Leonard Shabman*

The recent commitment to no net loss as the goal for the Nation's wetlands management programs follows a two-decade-long policy vacuum when no net loss was an implied, but not stated, purpose of wetlands management. Some economists might disagree. They would argue that the "public interest" review process of the Army Corps of Engineers required a case-by-case balancing of the costs and benefits of wetlands alteration--an economic efficiency program goal. However, this public interest review never achieved the analytical sophistication to support a benefit-cost decision rule. More important, a benefit-cost test was not employed as an organizing framework. Instead of determining the value of the site in alternative uses, a "water dependency" test was applied, and only those activities deemed water dependent were considered eligible for a permit. Then the regulatory process routinely denied wetlands alteration permits whenever it was "technically practical" to avoid the wetlands, with little recognition of the magnitude of forgone development values. Tradeoffs and consideration of opportunity costs, the central concepts implied by an efficiency-based decision model, had little influence in regulatory decisionmaking, and empirical expressions of these economic concepts in benefit-cost analysis had, and will continue to have, little bearing on the decisions on wetlands management.

The current articulation of the goal of no net loss is a formal acknowledgment that the trade-off decision rule implied by the conduct of a net benefit analysis for wetlands in different uses has been rejected. We are to maintain wetlands functions at present levels. Now, economists are left with two questions: (1) What defines the wetlands system to be maintained? and (2) How can we be most efficient in that maintenance effort? Therefore, despite my skepticism about the utility for wetlands management of benefit-cost studies, the need to incorporate basic economic principles in program design is imperative. My comments focus on urban development pressures on wetlands and agricultural reconversion of croplands to wetlands as part of a wetlands management strategy similar to one I articulated for coastal wetlands (Shabman and Batie, 1987). First, I will state four premises that form the basis for my argument.

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Premise 1: Public Concern is for Ecosystem Functions, Not Wetlands

Wetlands loss, per se, is not of concern. Concern is for loss of aquatic system functions. An aquatic system is the watershed where the complex of water, shorelines, and upland areas interact to support hydrologic and ecologic functions giving rise to services people value: clean water for recreation, intrinsic values, and habitat are examples. Wetlands type and wetlands location in the watershed landscape contribute to aquatic system functions.

While this basic point may seem obvious to the economist, it is not often considered in the management process, where existing wetlands acreage is asserted to have inherent value as a point on the landscape simply because it represents "nature." To ask for a demonstration that a wetlands type, in a given location, yields functions and services is to ask for a contentious disagreement with the regulatory agencies and with the environmental community. "If nature put the wetlands there, they must have aquatic system value," say the defenders of no net loss of acreage. But the remaining wetlands are not necessarily in the optimal locations or of the optimal types for the aquatic system. The wetlands that remain today are accidents of the development process as much as they are in ideal locations for the natural system.

To accurately consider wetlands functions in a wetlands management program requires a focus on aquatic systems and recognition of the fact that these systems are already heavily influenced and managed by human actions; wetlands management is a subset of aquatic system management. Today, there is increased policy attention to environmental management on the system level. In the Great Lakes basin, Canada and the United States are promoting the concept of "ecosystem" management. In the United States, a National Research Council Committee is in place to define and address aquatic system restoration. Implied by this new policy direction is the belief that one element of system management (for example, waste water treatment or wetlands restoration) must not be evaluated in isolation from other elements.

Premise 2: Some Wetlands are not Wetlands of Regulatory Concern

In the past, the type of wetlands acreage was used as a proxy for the wetlands functions within an aquatic system. Wetlands were the areas of land and water system interface, and the presence of these areas was of clear ecosystem value, albeit all wetlands did not make the same functional contribution.

However, what is a wetland? Recent procedures for delineating wetlands boundaries have been interpreted to mean that <u>most</u> wetlands are now dry all the time. In the past 2 years, Federal

agencies introduced a manual that defines a three-part test for determining when an area is a wetland. The area must have particular vegetation, a particular hydrology, and hydric soils. Of the three characteristics, only the hydric soil can be unambiguously identified. The ease of using the hydric soils criterion has led to a hydric soils definition of wetlands in the regulatory process. A hydric soil is one characterized by a high water table for a short period of the growing season, and hydric soils are now being defined as the wetlands base for implementation of the no-net-loss rule. Initial application of the soils criterion test in Maryland has defined as much as 70 percent of some counties as wetlands. This soils criterion may provide a clear-cut basis for drawing the lines on a wetlands map, but it does not represent the intent of the three-part test of the manual. Of particular note is that using this single criterion for delineation drastically expands the acreage of the Nation classed as wetlands, and this will be a major stumbling block to development of a wetlands policy. If wetlands management is defined as ceding as much as 30 percent of the upper Mississippi basin, more than 40 percent of the State of South Carolina, or as much as 75 percent of the land area of the rapidly urbanizing Hampton Roads area of southeast Virginia, then the debate over needed refinements in wetlands management will be overtaken by the debate over what is a wetland. Unless there is a desire to assert broad, new Federal and State management of land use, there must be renewed efforts to structure wetlands programs around hydrologic and ecologic functions within aquatic systems. The central management question must be what functions are performed by these soils in relation to the aquatic system. At the margin, where should a wetlands program focus? Where there is low return to the aquatic system for large acreages (all hydric soils) or where there is high return for small acreage (in riparian zones)? Simple management concepts, but presently absent from wetlands management program design.[6]

Premise 3: Development on Wetlands Will Occur

Population and economic growth make this premise almost not worthy of comment. Still the word "net" in no net loss is an important recognition that i) development of wetlands should and will continue to occur and ii) as development proceeds there will be efforts made to replace the functions of the wetlands that are

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[6] On September 9, 1990, the Corps of Engineers issued a regulatory guidance letter that exempted an estimated 60 million acres of currently farmed wetlands from the wetlands definition. While these lands have hydric soils, the Corps determined that due to their "prior conversion" these lands no longer served as wetlands within the aquatic system. However, it may be possible to restore these lands to wetlands status in the future. This regulatory guidance should substantially reduce the controversy over wetlands delineation. Still, the need to assure that wetlands of high aquatic system function value are the target of wetlands management programs continues.

altered. In this manner, development and environmental management are reconciled. The key then is institutional design to direct the effort of no net loss toward aquatic system management.

Premise 4: Wetlands Restoration is Possible

Developed and farmed wetlands can be restored to provide ecosystem functions. It may not be possible exactly to replicate the wetlands as they used to be, and it may not be possible to duplicate exactly the functioning of natural wetlands that now exist. What is important is to think of wetlands functions as they arise from the type of wetlands and their place in the landscape. In this view, it is not imperative that all restored wetlands be perfect nature substitutes. Preservation of a particular existing wetlands in time and space does not mean that the aquatic system realizes the greatest benefit. We need to rearrange the landscape, including wetlands, toward the goals of aquatic system functions. I am not arguing for "hard engineering"; "soft engineering," such as planting grasses and grading land, may do. But it is engineering nonetheless; human manipulation of the existing, already-altered landscape. Wetlands policy should be recognized as a resource management problem, not a preservation imperative, for in most cases the aquatic system is so heavily altered that it will not be possible to think of restoration in any terms except intensive land and water management.

How does agriculture fit into this argument? About 87 percent of wetlands loss in the Nation has been due to agriculture, but agricultural conversion of wetlands is the most reversible. As a result, it is in agriculture that we look for the restoration options that will allow development to proceed under a policy of no net loss that depends on restoration as offset for wetlands functions lost from the permitted development.

Toward Integrating Agricultural Reconversion into Wetlands Management

The central management tool for regulating urban development on wetlands is the Federal Government's permit authority under Section 404 of the Clean Water Act. Also, there are independent State regulatory programs that buttress the Federal program. Within the permit decision process, those who seek a wetlands development permit must demonstrate that they have considered all "practicable" alternatives to <u>avoid</u> the wetland, and that the desired activity is water dependent. If the permit is granted, some form of compensation for the lost wetlands, such as physical restoration or creation of wetlands, is expected. A technical rather than economic interpretation of the meaning of the terms "practicable" and "water dependent" has been used. The current permit process has little concern for the opportunity costs of forgone development. In my view, if forgone development values are exceptionally high, the development should be allowed to

proceed at the wetlands site, even if technically "practicable" but far more expensive alternatives exist. This modification to the current decision rules is one that can be an engine for a proactive wetlands program. I will call this a "share-the-gain decision rule," and will explain its linkage to agricultural reconversion.

I suggest that when a permit to develop is given, the required compensation should be in the form of a development fee, rather than requiring physical replacement by the applicant. Furthermore, I would encourage consideration of the value of development in establishing the fee, and an increased willingness to give permits whenever development values are "high." The development fee would have to include the cost of replacing the lost wetlands functions, plus an added increment. Anticipating one criticism I always receive of this idea, let me say at the outset that this decision rule need not be applied to all wetlands. Wetlands of high natural functional value would be declared off limits for development, and would be considered "wetlands wilderness" areas.

Consider a case where there is a decision to be made about a development permit application. The development would destroy one wetland unit. At present, every effort is made to deny the permit, with only limited regard for development values forgone. If the permit is granted, the applicant is required to replace the wetlands functions destroyed in close physical proximity to the site, paying a "price" for the permit equal to an acreage replacement cost of replacement. All the net economic returns for the development accrue to the developer. A different perspective suggests that if wetlands functions (which are public resources) are given up for development, then society has a claim on some share of the development benefits. When wetlands development has a high value, the permit fee structure could be designed to allow the development to move forward, then use fees collected to replace and then increase the lost wetlands functions.

Society has staked a claim on maintaining aquatic system functions through wetlands management, and society may be able to sell wetlands development rights at prices that will earn revenue to support aquatic system restoration programs. How might the fee system work? As one approach, there could be a valuation process within the permit process. The burden would be placed on the developer to show the costs of avoiding the wetland. This demonstration through data and analysis would be intended to establish the increased returns possible to the wetlands owner if the permit is granted. The sharing of the development returns would then be negotiated and the permit granted if the fee is adequate to achieve enhanced functions in the target aquatic system.

An alternative is to require replacement of wetlands functions at ratios such as 2:1, 3:1, 4:1, or more. If the developer is willing to pay to make such replacement, this is a signal of high development value. I recognize that either application approach

requires more careful program design than I can provide here. However, I believe this permit fee approach, based on development value and not on natural system value, can generate much needed revenues, earn the support of all interests, and result in a long-term enhancement of aquatic resources.

Why charge fees rather than having the developer physically replace wetlands as is now done? By having a restoration program financed by development fees, that is managed by wetlands restoration experts, the likelihood of successful restoration of aquatic system functions will be enhanced while holding down unit restoration costs. Of equal importance, this approach can elevate the focus of wetlands replacement to the level of the aquatic system from its current emphasis on acreage replacement at the closest nearby site.

With the fee structure concept, it would be possible to develop aquatic system restoration plans on a watershed scale and then begin to implement those plans, perhaps with initial financing by an aquatic system restoration fund capitalized with general tax revenues. Development fees could be collected to repay the general revenues which provided the original financing. For example, areas of currently drained cropland which would have particular aquatic system value if restored to wetlands might be identified in a plan. Using existing programs such as CRP, perhaps supplemented with State funds, as is now done in Virginia and Minnesota, landowners would be paid to return the lands to a wetlands hydrologic condition. Development fees from wetlands permits granted in other areas could be returned to the restoration fund to allow further restoration to occur. An example of how inexpensive such restoration might be is illustrated by the study which Randall Kramer and I recently completed for Delaware. On marginal croplands, which had been drained in the past, it appears that the wetlands could be restored by abandoning the drainage ditches and bedding up areas to be planted to softwood timber. If the several forestry incentive payments are considered, an annual payment to the landowner of as little as $15 per acre would make the owner financially indifferent between the wetlands forestry alternative and continued crop production. For a number of institutional reasons, I am certain that payments of perhaps three times that amount may be needed to actually get this restoration adopted; and a perpetual wetlands easement may cost about $400 to $500 by these crude calculations.

My point is simple. Put the burden on developers rather than the general taxpayer to pay for aquatic system restorations, and rely on the use of a fee structure to rationalize our present wetlands management system, which is focused too much on preservation of existing wetlands, and not enough on the restoration of aquatic systems.

Questions and Answers

Goldstein: The National Wetlands Inventory is a critical element in the effort to conserve wetlands. It has a carefully structured, statistical design, and relies on aerial photography and professional photo-interpretation for its estimates. The Fish and Wildlife Service compared aerial photographs from the mid-1950's and the mid-1970's in order to estimate the loss of wetlands nationally over that period.

Leonard, in another forum, has contended that regulation has evolved and become more stringent since the 1970's, and this, together with increased mitigation requirements in public works bills and reductions in incentives to convert wetlands, has vastly slowed the rate of loss. Preliminary estimates from the updated National Wetlands Inventory indicate that the rate of loss has indeed slowed, declining from 458,000 acres per year between 1955 and 1975 to less than 300,000 in recent years. However, that is still a far piece from no net loss, yet you concluded we may be near no net loss. How do you come to the conclusion that we may be close to no net loss?

Shabman: My point was that after the 1955-1975 loss trends were published, the Office of Technology Assessment (OTA) made an effort to say what the post-1975 wetland losses were (OTA, 1984). OTA went to George Pavelis' preliminary agricultural drainage data for the post-1975 period and used those data as a proxy for wetland drainage. The preliminary Pavelis data showed continuing drainage, and OTA used this to conclude that agricultural drainage was continuing at 1955-1975 levels. This became the conventional wisdom. Subsequently, Pavelis published the final data set, which was a revision of his preliminary data (Pavelis, 1987). It showed that drainage projects had practically ceased between 1975 and 1983. My point is that we often cite "facts," here the OTA conclusion, and never know where they come from. I argued that there were many reasons to expect a decline in wetlands drainage, especially since 1985, but one thing was certain: we did not know the post-1975 losses and will not know them until new wetlands inventories from FWS and SCS are completed. USDA recently estimated wetland losses from 1982 to 1987 at 100,000-200,000 acres per year, based on its Natural Resource Inventories for those years (USDA, 1990). The National Wetlands Inventory Status and Trends analysis for 1975 to 1984 will be out soon and will probably also show less wetland drainage than the 1955 to 1975 figures. Still, figures pertaining only to losses since 1985 will not be available soon.

G.C. Van Kooten, University of British Columbia: Andrew Schmitz and I are doing a study in Canada on potholes. The region in Canada that we are talking about, being the Southern Great Plains, produces something like 30 percent of the migratory waterfowl. We find a number of different things than what I am hearing here.

We are finding that draining these potholes is an irreversible process. It has to do partly with climate, and partly also with the way that they are drained.

My concern is that the biologists and other physical scientists are running the wetland programs. We were called in late in the design of the program we are studying and the program was already underway. What the biologists wanted was a socio-economic analysis, not an economic analysis. We could not even get our proposal accepted unless we had a sociologist on board! The reason was because the biologists believed that they had to change the attitude of the farmers toward conversion of wetlands, as opposed to changing economic incentives.

Now, we do not have any economic incentives in Canada to preserve, let alone restore, waterfowl habitat. In fact, when you look at the Canadian Wheat Board, when you look at the special grains program, when you look at crop insurance, each of those programs is designed to encourage farmers to get bigger and to convert marginal land, in this case wetlands, to crop production. We are finding exactly the opposite of what you are saying. Wetlands conversion is occurring at an increasing, rather than a decreasing, rate. In southern Saskatchewan, there were small farmers that had some livestock and a grain operation. They sell out, and in comes a big farmer who is not interested in livestock, and converts the wetlands. That is what we are finding is the problem.

Goldstein: I am a bit surprised to learn that you are not finding it possible to <u>restore</u> wetlands. I know that it can be difficult to create them. But the U.S. Fish and Wildlife Service has found many opportunities to restore them. Both the Farmers Home Administration program, alluded to by Ralph Heimlich, and the revamped 404 regulatory program rely heavily on the ability to restore wetlands, just plug a drain or fill a ditch and pretty soon you have a wetland.

Van Kooten: It has to do with drought, too. If you do not have enough water, you cannot make a wetland. We are talking about a region which the climatologists predict will be semidesert in 25 to 40 years time. But they are also filling them in, rather than just draining them. Farmers are also worried about soil salinity. The soil scientists are telling farmers that, in part, soil salinity is the result of having wetlands which raise the water table.

Heimlich: There is a lot of experience under the Conservation Reserve Program (CRP), where a lot of the land that came into CRP was restored to wetlands through the Reinvest in Minnesota (RIM) program, which provided additional incentives, and the Fish and Wildlife Service worked with the landowners. In a number of projects RIM and FWS have successfully been able to restore the hydrology, and the vegetation comes back rather quickly as long as dormant seeds have not been buried too deeply.

Tom Hebert, Staff Economist, Senate Agriculture Committee: The issue of restoration is critical. For the wetland reserve in the 1990 Food, Agriculture, Conservation, and Trade Act to be successful, at least half of the wetlands that are envisioned for the program will have to be restored. The thinking was that we did not particularly want to pay to preserve existing wetlands, if they are going to be relatively well protected under Swampbuster in parts of the country where the program participation is pretty high, or by other programs. If it is true that we cannot restore these wetlands, Congress just went through some significant pain in order to develop a restoration program that may not produce results. I hope it is not true.

Shabman: EPA has just published a three-volume set of research results on restoration (U.S. Environmental Protection Agency, 1989). While restoration results are mixed, I believe the potential for restoring drained agricultural lands was documented. One of the things that is striking in talking about restoration is something I alluded to in my remarks. It may not be possible to get back the wetlands nature put there, but that is not the point. We should be thinking of wetlands restoration at a higher level, in terms of desired aquatic systems. That is, water quality, number of birds and fish, and so forth. A lot of the debate on the possibility of restoration is based on comparing the structure of the restored wetlands with the wetlands replaced in terms of soil profiles and numbers of reeds in the water and that sort of thing. Economists really need to keep reminding the biologists that it is not the physiographic features we care about, rather it is the functional values that arise from any wetlands structure and their place in the watershed landscape.

Heimlich: Let me give an excellent example. Particularly in the southern part of the country, in the bottomland hardwood areas, the naturally occurring wetlands are seasonally flooded, hardwood forested swamps. The cost of getting the hydrology back may, in many cases, be fairly reasonable. The cost of getting those hardwoods back is going to be enormous. As Leonard points out, reforestation may not be necessary to achieve a valuable wetland, even if the wetland does not achieve identical vegetation found in the area.

Tony Prato, University of Missouri: I wanted to ask a question of any of the panel members on the importance of constructed or created wetlands. The city of Columbia, MO, has decided to use a 90-acre wetland to receive the secondary effluent from their municipal wastewater treatment plant, and the Department of Conservation is putting a 2,000-acre wetland next to the 90-acre one to use the water coming off the 90-acre wetland. How important are these constructed or created wetlands in terms of the goal of no net loss?

Goldstein: If the National Wetlands Inventory (NWI) final estimates continue to show a significant rate of loss, something on the order of 300,000 acres a year, then restoration cannot play the dominant role in the strategy to reach no net loss. It

is very hard to create or restore that amount of wetlands annually. My view is that we are not going to be able to have development as usual, while relying on restoration and creation to offset the losses and achieve no net loss. I think we are going to have to focus on reduced incentives and to direct development away from wetlands, and that could prove costly.

Shabman: Jon, do you know how much of the total loss estimated by the NWI is because of Louisiana washing away? The point here is that losses of Louisiana coastal wetlands are qualitatively different than conversion of wetlands for other land uses.

Goldstein: Louisiana is clearly washing away, but at the rate of 50-60 square miles annually it might account for 10 percent of the national losses.

Clay Ogg, EPA: Leonard Shabman was suggesting that an economic system of valuing wetlands and managing them was needed. Where are we in terms of being able to do that? My impression is that the biological information on productivity of wetlands in many parts of the country has been quite limited, and being able to pinpoint which wetlands you would want through an economic analysis at this point would be very difficult.

Shabman: I think that is for John Bergstrom to answer, but I support your statement. That is the fundamental reason we cannot do those valuations. I think John Bergstrom and others working in this area have probably run up against the problem that the physical scientists cannot tell you enough about the "production function" of natural wetlands to allow an economist to do an economic valuation.

Bergstrom: This relates to the question about constructed wetlands as well as our ability to do valuation studies. The one concern I have with the constructed wetlands is at what level do we want to look at no net loss. Do you want to talk about just replacing physical wetlands? Should a distinction be made between artificial, natural, or constructed, or as Leonard has suggested, should we just be focusing on the function? If we just want to mitigate the function, for instance waste treatment, we can build a waste treatment plant. In our definition, we are focusing on the level of the service for mitigation. That is, to replace the service provided by the wetland. With regard to constructed wetlands, is there a fundamental difference between going hunting at a constructed wetland versus a natural wetland? Can those really be substitutes?

We also have problems linking wetland construction or restoration and wetland functions. In our study, we had a big problem with the biologists coming late in the study. We had already gotten far enough along in estimating the relationship between waterfowl hunting bag and other services and economic value. When we met with the Corps of Engineers, we said that to implement this valuation scheme, you have to come up with a model that links changes in wetland acres and habitat to changes in waterfowl bag and success. The biologists could not do it, and we economists

could not do it either. It seems that economists have to reach backward, and the biologists have to reach forward, and through some kind of division of labor, model these things.

Prato: The point I am trying to make is that simply to think about "restoration of aquatic systems" is too narrow an objective. A constructed wetland has the benefit of treating sewage effluent and improving water quality. Yes, it also has other benefits of creating a wetland environment, but I think we have to look at the multiple uses or functions of wetlands. One of the reasons Columbia decided to go with a constructed wetland is that not only did it handle the effluent problem, but it also created wetland amenities, that, from an environmental point of view, were receiving a lot of support.

Heimlich: The economists, and maybe worse, the engineers, will say, "Yes, we can replace the wetland function of flood control with a dam, and we can replace the function of water quality improvement with a sewage treatment plant, and we can replace the habitat function with a zoo." But then what you have got is a set of substitutes for an aquatic system, designed by a committee. It is not the same thing, and it is probably going to be more expensive to replace all of those separate functions separately. I do not think Leonard's arguing for that.

Shabman: No, I am talking about "soft" engineering here, not pouring concrete. I am talking about managing the aquatic system, letting the biologists do the design work instead of civil engineers.

Pat McGregor, Open Space Resources Coordinator, City of Davis, CA: The Corps of Engineers and EPA say you cannot mitigate for a different type of wetland in a different location. You have to create the same kind of wetland in an adjacent area. We are facing the situation where a developer cannot hand us the money to mitigate wetland losses because it will pay for a different type of wetland, too far from the site. So, in our case we are looking at constructing the same kind of wetland that Tony Prato spoke of, an extended overland flow facility for water treatment, and to create a wetland as well. The Fish and Game Department is considering developing an adjacent wetland so the site would be one major wildlife area. It is hard to increase the amount of wetland in that same area in exchange for development.

Goldstein: I think that you largely support Leonard's point. The method now incorporated in the 404 regulatory program is very expensive. According to the EPA/COE Memorandum of Agreement on mitigation, account is to be taken of the function of the wetlands lost due to a development project, and they are to be replaced as close by as possible. That means they will be replaced, function for function in the same area. Leonard's plan is quite different, but it does rely heavily on restoration technology. If, according to Leonard's plan, we were to sell the right to convert a wetland, collect the money in a central place, and give the power to departments of natural resources, the Fish and Wildlife Service, or EPA to manage wetland ecosystems as they

saw fit, it would be much cheaper than the current system. But the *sine qua non* of this more economical approach is creation and restoration. Without the technology to create and restore wetlands, the plan will not work.

Bob Davis, Department of Interior, retired: Leonard would use the developed value as the permit fee. It seems to me that would miss the opportunity to have a kind of self-regulating efficiency mechanism, with the fee value based on the wetland value. Maybe we cannot estimate that well enough, but why do you choose the development value?

Shabman: First, let me say that the fee is based on a share of the incremental gain from development on a wetland versus the next best alternative non-wetland site. Development proceeds only if that fee is at least sufficient to restore wetlands elsewhere in order to achieve no net loss. This is analogous to an effluent tax based on the cost of waste treatment. The effluent fee structure is a means to assure that the tax will induce waste management decisions that maintain an environmental standard. The fee is based on the "average" marginal cost of treatment, not on environmental damages. Waste producers with higher than the average marginal cost pay the fee and dump their waste. Those with lower than average withhold their waste. The effluent tax was originally based on the water quality damages, but we evolved from that very quickly to an effluent tax based on the cost of waste treatment. The reason, as it is here, is because we cannot readily estimate environmental damage functions.

In my proposal for wetlands, the environmental standard is no net loss of wetland function in a watershed. The wetland fee is intended to assure that outcome in an efficient manner by allowing those developments with high marginal cost of avoiding wetlands to proceed to develop the wetland and thus restore wetlands elsewhere. If the incremental gain to development of the wetland site is low, then the gain to be shared will be small, perhaps too small to pay for the restoration. That type of development would not proceed. Ultimately, my proposal is structured as it is for the reason you gave. We cannot have a pure Pigouvian tax because we do not know what the environmental damage function for wetlands development looks like.

Heimlich: Many in the agricultural community are amazed at the power of the environmental lobby to control the policy agenda in the farm bill debate. They view the Swampbuster provisions as regulatory and confiscatory. From your experience with nonagricultural wetlands, are farmers being unfairly singled out with regard to wetlands policy in Swampbuster and Section 404?

Shabman: Under the Section 404 program, agriculture is under far less scrutiny than others. However, three facts must be recognized. First, most wetlands loss has historically been to agricultural drainage. Second, many acres of wetlands remaining are in rural areas. Third, restoration of agricultural wetlands

is the most practical of all restoration activities. For these three reasons, farmers' relationships to wetlands are being intensively examined.

However, the pressure on agriculture has been lifted somewhat by the Corps of Engineers' decision to exempt farmed wetlands that had been converted prior to 1985. Contrary to penalizing farmers, somewhere between 30 and 55 million acres of the wetlands (over which the most controversy in applying Section 404 has developed in recent years) are now excluded from permit requirements because they offer little wetland functional value that would benefit from protection. This action is a second step in making Section 404 and Swampbuster consistent. First, the Corps, EPA, USDA, and FWS agreed to delineate wetlands on the more comprehensive basis of hydric soils, hydrophytic vegetation, and hydrology. Now, the Corps has lined up with USDA in excluding prior converted wetlands that meet the three criteria in the delineation manual from permit requirements, just as USDA excludes them from Swampbuster penalties. However, it is true that agricultural development of existing wetlands has been brought under more intense 404 review in the past year.

Question: Many farmers claim that if the Federal Government wants to tell them what they can do with their land, they should compensate farmers for taking their property. Will this ultimately destroy regulatory approaches like Section 404?

Heimlich: In general, Section 404 has been upheld as a valid exercise of regulatory authority. That is partly a result of Congress cautiously tying Section 404 to the well-established authority of the Corps over navigable waters, and partly to the fact that some economic use of any parcel remains, even if development on wetlands is ruled out. As late as 1985, in United States v. Riverside Bayview Homes (474 U.S. 121, 128), the U.S. Supreme Court declined to award damages for a taking under Section 404. However, two recent decisions in a Federal claims court in Florida bear on the "taking" issue with regard to wetlands. In Florida Rock Industries, Inc. v. United States and Loveladies Harbor, Inc. v. United States, (1990 U.S. Claims Court Lexis 280 and 281, July 23, 1990), the court awarded damages to the plaintiffs, arguing that the Federal Government's denial of Section 404 permits resulted in a taking requiring just compensation under the Fifth Amendment. If these decisions are upheld on appeal, farmers and others may increasingly take wetland permit actions to court. At the very least, the Corps and EPA may be more circumspect about permit decisions that remove a substantial part of the economic value of a parcel to avoid a taking, as required by Executive Order 12630 issued in 1988 (Federal Register, 1988).

But economic losses to agriculture from denying a permit are generally much smaller, especially on a per-acre basis, than losses to urban developments. Also, owners of most farmed wetlands can continue to farm those lands as they have in the past. They are barred from making any further improvements that

require filling. Of course, Swampbuster is not regulatory at all, in the sense that Section 404 is, because it simply sets conditions on receipt of payments in a voluntary program. Those payments are not, in any legal sense, an entitlement or right associated with private property.

Leonard, your scheme for compensating society for wetlands loss on the basis of the producer surplus created by development on wetlands implicitly assumes that the development value is greater than the wetland value. This may be generally true for urban developments (condos, marinas, and so forth), although I am not convinced in the case of residential developments. However, it is likely not true for agricultural development, particularly for program crops already in substantial surplus. Under your scheme, would not public officials still have to value services and functions on wetlands proposed for development in order to know whether the public is getting a "good deal" by taking the developer's/farmer's money?

Shabman: I do not agree with the premise of the question, that development value is presumed greater than natural wetland value. My proposal is one for implementing no net loss. Under a policy of no net loss any development of a wetlands is accompanied by a replacement of the wetlands functions lost. As I noted, no net loss as a goal rejects the type of benefit-cost balancing that the question suggests. If there is a concern about finding the correct balance between developed and natural wetlands, that concern is about the goal itself, not my suggestion for its implementation.

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