Policy Alternatives to Achieve a Dramatic Reduction in Environmental Impacts from Midwestern Agriculture

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In 1996, WWF started a project to look at Midwestern agriculture and ways to minimize its impact on the environment. The initiative focused on the commodification of agriculture and tried to identify potential entry points and policy interventions to move the production system toward environmental sustainability. Through a series of vertical case studies, related policy analyses and roundtable meetings, WWF examined the environmental impacts and the political economies of the midwestern corn, soy and beef industries.

The partners asked five authors with very different perspectives, to write a white paper addressing the topic: reduce the environmental impacts our present Corn Belt production system by 50 percent using both short-term and long-term solutions.

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WWF-US Sustainable Commerce Program

This report was prepared in coordination with the Sustainable Commerce Program. Since its inception in 1993, the Sustainable Commerce Program has been dedicated to promoting conservation through engagement with public policy issues surrounding trade, investment, and international commerce. The Program’s objectives are to help create the policies, and processes needed to make international commerce sustainable in both human and ecological terms.

For more information on WWF's Commodities and Conservation Initiative, please visit our website at: www.worldwildlife.org/commerce, or contact:

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ABSTRACT
Building on impressive reductions in soil erosion, Midwestern U.S. agriculture needs to make comparable strides in the areas of water quality and wildlife habitat, while reducing soil erosion even further. This position paper proposes three policies to achieve these goals. An improved program of land set-aside and habitat service contracting would target all three goals on lands offering high benefits relative to costs. A “green payments” program would target environmental outcomes tailored to regionally established priority areas. Newly designed tradable permits programs would offer farmers a means to earn added income by reducing nutrient discharges to water and greenhouse gas emissions to the air. Apart from start-up expenses, these programs could be designed to maintain costs in line with current conservation and agricultural income support programs.

THE CHALLENGE
1.a. Environmental challenges to Midwestern Agriculture
Midwestern U.S. agriculture faces challenges to improve its environmental stewardship, particularly in the areas of water quality, soil conservation, and native wildlife habitat. Alongside these challenges come opportunities to make relatively low-cost changes in agricultural practices to achieve high-value pollution reduction goals.

Agricultural water quality problems come from nutrients – both mineral fertilizers and livestock manure – and from pesticides. Nutrients such as nitrates, phosphate and potassium can lead to algal growth that removes available oxygen from water, creating a “hypoxic” environment that kills most aquatic life (NOAA 1999). While this problem is not new, the magnitude of the hypoxic “dead zone” in the Gulf of Mexico has become alarming; the problem appears to originate from excess agricultural nutrients carried from the Midwest by the Mississippi River. Apart from the aquatic environment, nitrates in drinking water are also known to cause human health problems, notably “blue baby” syndrome in infants. Due to the large quantities of fertilizers applied to field crops and manure excreted by livestock, agriculture in the Midwest has been identified as a major contributor to “nonpoint source” water pollution (Runge and Stuart 1997; Conner et al. 1999; Schnittker 1997; Faeth 2000).

Pesticides remain a problem for water quality (Runge and Stuart 1997), despite the fact that pesticide rates and treated area in major crops have stabilized in recent years (Fernandez-Cornejo et al. 1998). Total pesticide usage is greatest in Midwestern field crops, notably corn and cotton, although per-acre usage is far higher in fruit and vegetable crops. Recent work by Smith et al. (2000) suggests that pesticides have had less impact on overall water quality and wildlife habitat than have water-borne nutrients. However, estrogenicity and endocrine disruption have recently joined toxicity and carcinogenicity as causes of public concern about pesticides (Colburn et al. 1996; Safe et al. 2000).

Midwestern agriculture has made great strides in reducing soil erosion over the past seventy years (Runge and Stuart 1997; Claassen et al. 2001). However, sediments remain a significant water quality problem, both for navigation and as contributors to nutrient loadings.

Wildlife populations had been declining in the Midwest for most of the 20th Century as agricultural and urban expansion overwhelmed native habitat. The Conservation Reserve Program (CRP), begun in the mid-1980’s, has shown that by retiring land from agricultural use, native habitat loss is reversible (Ogg 1999). Soil conservation is the major focus of the
CRP and the related Conservation Reserve Enhancement Program (CREP). Future habitat benefits could be enhanced by increased support for programs targeted at wildlife, such as the Wildlife Habitat Incentives Program, a cost-share program introduced in 1996 that has received very limited funding to date.

**1.b. Potential for “dramatically reducing environmental impacts”**

The magnitude of environmental impacts suggests ample potential for dramatically reducing them. The trick is to accomplish this reduction while maintaining the economic vitality and productivity of Midwestern agriculture. To date, Midwestern agriculture has not faced the regulatory pressure that has wrung dramatic improvements in environmental performance from industries and municipalities that generate “point sources” of air and water pollution.

Farmers’ property rights over their land shape the feasible ways to reduce environmental impacts from agriculture. For point-source pollution, U.S. courts have put the public’s rights to clean air and water ahead of industries’ and municipalities’ rights to manage their production processes. The resulting principle has been dubbed “the polluter pays.” Responsibility for nonpoint-source pollution is less clear cut. For rural land in the United States, established private property rights allow great leeway for agricultural management practices. At the federal level, the only major incursions on agricultural management freedom have arisen from threats to human health via pesticide use and/or occupational safety of farm employees. Hence, the precedent for mandating a dramatic reduction in environmental impacts from agriculture is weak. Instead, major change must come from upon policies that are voluntary.

**VISION**

**2.a. Operational vision of a transformed agricultural landscape**

Dramatic improvements in the environmental impacts described above would result in a landscape marked by clear streams contributing to a Mississippi River that poured water low in sediments and plant nutrients into a Gulf of Mexico alive with marine fauna. A lacework of uncultivated prairie, brush and forested patches would offer wildlife corridors across the Corn Belt. New farm buildings would signal prosperity earned from sales not only of agricultural commodities, but also of environmental services. Rural regional centers would be thriving, not only with agribusiness, but also with earnings from agrotourists and outdoor recreation lovers.

**2.b. Needed changes in land use and agricultural production patterns**

In order to achieve this vision, changes will be needed in what farmers produce and how they do it. But more fundamentally, perceptions will have to change about what it means to farm. The first perceptions to change will have to be those of American society – viewing farmers not simply as commodity producers but as stewards of the land who can provide many different ecosystem services if society cares to offer suitable incentives. Among farmers, the perception will have to grow that farming can offer many products and services, commodity production among them, but including such diverse services as outdoor recreation, wildlife management, reduction or sequestration of greenhouse gas elements, and even aesthetic landscape management. Along with this perception of varied goods and services that could be offered, farmers will have to acknowledge more fully their role in protecting the wider society from agricultural risks to water and air quality.
More land devoted to native wildlife habitat would be part of the pattern. Some might be leased by the federal government, but some could also be compensated for the management of specific wildlife species or subsystems, allowing limited agricultural production at the same time.

Specific changes in agricultural production patterns are harder to envision, because these would be triggered by changes in incentives to provide environmental services. Those incentives would focus on environmental outcomes, leaving farmers the freedom to achieve them in the lowest cost fashion possible. While it is likely that some changes would reduce fertilizer, manure or pesticide use, it is equally possible that other changes would involve safer pesticides or water treatment to remove pollutants before they reach public waterways.

2.c. **Currently available options to achieve dramatic reduction in environmental impacts**

Current options for reducing environmental impacts include changes in land use, production technology, and pollution treatment technology. Land set-aside programs like the Conservation Reserve Program (CRP) can generate varied environmental services including native wildlife habitat, soil conservation, and much reduced pesticide and nutrient escapes into public waters. But the opportunity cost in lost agricultural production can be large when food prices are high. Environmentally beneficial agricultural technologies include:

- integrated pest and nutrient management (where agrochemical interventions occur on an as-needed, just-in-time basis),
- ecosystem management (where farming embraces wild species that offer pest control or nutrient secretion services),
- genetic improvements that imbue pest resistance or greater nutritional self-sufficiency,
- tillage methods that reduce soil loss.

Treatment technologies for agricultural pollution have been little discussed, but these can include animal sewerage treatment, pesticide residue removal, and water treatment to precipitate sediments and remove agrochemicals.

Adoption of environmentally beneficial production and treatment technologies has been and can be encouraged by information dissemination, cost-sharing (to reduce costs to farmers), and “green” labeling (to boost revenues from farm sales). Although largely untested in the agricultural realm, other possibilities include trading of marketable pollution permits for water-borne nutrients or airborne greenhouse gasses (discussed further below). Moving beyond these incentive-based approaches, environmental performance can be regulated by mandating standards or taxes on input use, production practices, or environmental outcomes (Batie and Ervin 1999).

**POLICY IDEAS**

Before outlining policy options, it is worth considering criteria for policy design. First and foremost, a policy should have a high probability of accomplishing its goals. For environmental policy, this means targeting the desired environmental outcome. For policy aimed at agricultural management, it typically also means tailoring the policy toward a specific agricultural production setting. Implementation of any policy costs someone money – whether taxpayers, farmers or industry – so cost-effectiveness matters too. Finally, political feasibility is a *sine qua non*: for a policy to be effective, it must first be enacted.

3.a. **Policy options**
Policy options fall into three major classes: 1) informational, 2) incentive-based, and 3) regulatory. These deserve exploration in terms of the four main policy objectives: water quality, wildlife habitat, soil conservation, and climate stabilization. While most agro-environmental policies have been targeted at the farm, they can also target other parts of the food and fiber system with the ultimate goal of changing farm-level incentives.

U.S. agricultural policy has long engaged in informational programs for research, outreach, and product grades and standards. For environmental goals, the U.S. Department of Agriculture (USDA) informational programs are well established and deserve to continue. New roles are emerging in the grades and standards area. Nascent research into green labels suggests possibilities for governmental or nongovernmental organizations to certify that farm production conditions meet environmental or food safety norms (Blend and van Ravenswaay 1999; Nimon and Beghin 1999; Ervin and Casey 2000). To the extent that such labels attract consumers to pay higher prices, they may more than offset the added management costs. The chief limitation of informational policies is that they induce only marginal changes, with is no assurance of the extent or incidence of changes that may result.

The realm of direct policy incentives offers a much wider range of tools – all predicated on the assumption that economic actors have access to good information. Three types of policies can combine to make significant improvements in the environmental record of Midwestern agriculture:

1. Leased land set-asides and habitat service contracts,
2. Green payments for specific environmental outcomes,
3. Tradable permits for water pollutants and greenhouse gas emissions.

Each is discussed in order.

*Leased land set-aside and habitat service contracts*
For the purposes of biodiversity preservation, water quality and soil conservation, no change in agricultural management practices can equal the impact of withdrawing land from agricultural production. Since evaluating set-asides on the basis of the Environmental Benefits Index post-1996, the CRP and the Wetlands Reserve Program have combined biodiversity with soil conservation and other objectives to capitalize on the multiple benefits attainable from land set-asides (Heimlich and Claassen 1998). However, these programs come at fairly high cost, since farmers must be paid enough to remove farmland from agricultural production (Claassen et al. 2001). Yet there exist cases where the public seeks specific ecosystem services that may be compatible with certain agricultural land uses. In such instances, the most cost-effective use of government funds may be to purchase just those services most desired – habitat of a threatened animal species, for example – rather than to pay for complete land set-aside from agriculture (Roka and Main 1999).

In cases where agricultural land is to be set aside, it makes sense to define units that generate greatest the public benefits. USDA’s valuable Environmental Benefits Index (EBI) needs extending to spatial geometry. Some wildlife studies have found that refugia are best connected to facilitate animal migration. But more research is needed on how patterns of uncultivated land affect biodiversity and how much crop production enhanced on adjacent fields by pest predators harbored in hedgerows (Landis et al. 2000). In short, biodiversity and conservation programs should continue, but they should be enhanced both by identifying
specific ecosystem services for targeted support and by refining criteria for choosing land in order to set aside to ensure wildlife habitat benefits.

**Green payments for specific environmental outcomes**
The most cost-effective means to improve water quality and soil conservation are not by removing small areas of land from agricultural production, but rather by changing the management of the vast areas that remain under cultivation. To date, most U.S. agro-environmental policies have focused on encouraging the adoption of specific, environmentally beneficial farming practices. For example, no-till farming and planting of riparian buffer strips to deter erosion have received cost-share subsidies under the Environmental Quality Incentives Program (EQIP) and related programs. Use of basic soil conservation practices has become a prerequisite for participation in USDA income support programs (“conservation compliance”). These programs have contributed to the adoption of conservation tillage and to marked reductions in soil erosion over the past twenty years (Hrubovcak et al. 1999; Claassen et al. 2001).

“Green payments” refer in general to government payments to farmers for environmental services. As such, these include the EQIP cost-share subsidies noted above (Batie 1999). But a more comprehensive green payments program could be the next step in the succession of federal transfers to farmers for price support, income support or supply reduction (Lynch 1994; e.g., U.S. Senate 2000). The focus here will be on how to design a program with the greatest environmental impact per dollar spent, despite the fact that such a single-objective focus will make secondary other desirable program objectives such as equity.

Optimizing the environmental “bang for the buck” calls upon two principles. First, environmental **outcomes** should be the focus, rather than the agricultural practices expected to produce them. To see this, consider a sum of money that could be spent on subsidizing conservation tillage equipment to leave 30 percent crop residues on 100,000 acres of cropland. The same sum could achieve more reduction in soil erosion and nutrient runoff if it were targeted to reward farmers for erosion reductions. In the latter case, farmers would choose to focus their efforts on highly erodible land, using a variety of practices locally tailored to get the best soil conservation results. So targeting environmental outcomes can enhance cost-effectiveness where the costs of measuring the outcome are not prohibitive.

The second principle is to prioritize by level of expected environmental benefits. The benefits of pollution control are greater in some places than in others. Classen et al. (2001) illustrate how the water quality benefits of reduced nutrient loads are greatest near coastal estuaries. The EBI could be adapted for this purpose.

Environmentally efficient green payments should be targeted at specific environmental outcomes in places where those outcomes have highest value (Batie 1999). The challenges are to identify the outcomes and how to measure them. A tailored program would vary regionally. This would offer two important benefits. First, it would zero in on the most locally important environmental problems. Second, it would give a politically advantageous rationale for ensuring the eligibility of farmers who had previously benefited from commodity program payments, even in regions where environmental vulnerability is not especially high.
Actual field verification of nonpoint source discharges can be prohibitively costly, so certain environmental outcomes should be measured by computer simulations, based on actual farming practices and modeled environmental conditions. Simple simulation models like the Universal Soil Loss Equation (USLE) have already been used for targeting CRP leases (Claassen et al. 2001). But computer modeling can only play a supporting role; there will still be a need for ground truthing of both environmental compliance and impacts.

From the standpoint of political feasibility, it is imperative that a green payments program be equitable in its treatment of environmentally beneficial practices. Despite some budgetary efficiency losses, the equity maxim would imply supporting practices that yield good outcomes rather than measured improvements, as the latter would penalize those who had adopted good stewardship practices early (Claassen et al. 2001).

** Tradable permits for nutrient discharges and greenhouse gas emissions**

Motivating farmers to continue improving stewardship beyond what is required to obtain green payments is the next step. Such motivation could be engendered by programs that give lasting value to improved environmental outcomes. In the arena of water quality, the Clean Water Act (CWA) has the potential to offer such incentives. The CWA regulates pollution discharged into the nation’s navigable waterways. Under the Act, the states must develop for each major watershed a set of total maximum daily load (TMDL) levels that can be permitted for a variety of water pollutants, including nutrients like nitrogen and phosphorus. Once developed, the TMDLs must be approved by the Environmental Protection Agency (EPA). Industries, municipalities and concentrated animal feeding operations that operate distinct “point” pollution sources are required to reduce their effluent to keep waterways below the specified TMDLs. Up to now, “nonpoint” source polluters, including most farmers, have not been required to comply with the CWA due to the difficulty of measuring their effluent.

The opportunity through the CWA is for nutrient trading. Attempted so far only in test watersheds, nutrient trading becomes possible when regulators designate point source wasteload allocations and nonpoint source load allocations that sum to the acceptable TMDL of water pollutants. These allocations could function like pollution permits. A farmer who adopted improved agricultural management practices could reduce his estimated nutrient discharges. His surplus nutrient discharge permits (the difference between his original load allocation and the estimated discharges with his new practices) could be sold to industrial or municipal point sources whose discharges exceed the wasteload allocation, but who find it cheaper to buy permits to offset their higher discharges rather than invest to reduce their discharges (Baumol and Oates 1988; Ribaudo and Caswell 1999). Given that many industrial plants and municipalities have already made investments in reducing discharges under the CWA, it is plausible to expect that farm nonpoint sources could make discharge reductions at lower cost – and hence have surplus nutrient permits available for sale without exceeding the watershed TMDL (Faeth 2000). In effect, nutrient trading could pay farmer volunteers to provide the service of cleaner water in exchange for accepting legal responsibility to behave as promised (Ribaudo and Caswell 1999).

A similar market for tradable permits could conceivably be applied to greenhouse gasses (GHG). GHG emission permits would be most in demand from energy companies, since fossil fuel combustion is the leading source of GHG. Farms can reduce GHG effects both by reducing emissions and by sequestering carbon in trees and soil. Carbon sequestration is an attractive idea, but given that the carbon cycle is in a normal state of flux, it is unclear how it
to ensure that carbon, once sequestered into soil, is not released again (Rosenberg and Izaurralde 2000). By contrast, it appears that reduced agricultural nitrogen use (in fertilizers and manure) could cut nitrous oxide emissions, which have 310 times the global warming effect of an equivalent amount of carbon dioxide (Faeth and Greenhalgh 2000). Similarly, livestock methane emissions (with a 21X GHG impact) could be reduced by changed feeding patterns (Conner et al. 1999).

3.b. Major impacts and constraints to implementation of these options
The major impacts of the proposed policies will depend upon the environmental outcome levels targeted, regional agro-environmental characteristics, and funding levels. Viable target levels for the environmental outcomes of a green payments program should be based upon scientific research, as are ongoing efforts for watershed TMDLs under the Clean Water Act. The impacts of native habitat preservation and land retirement will likely depend primarily on available funds and CRP acreage allotment.

By design, the impacts of a major nutrient trading program will be uneven, because the program should be administered on a watershed basis. The unevenness arises from the fact that the watersheds with the most serious excess nutrient problems would be the ones compelled to make the biggest reductions to meet TMDL caps. The opportunities for farmers to make money from cutting nutrient runoff would be greatest in the problem watersheds, which include large portions of the Mississippi and Great Lakes watersheds that cover the Midwestern United States.

The major risk to using nutrient trading for water pollution reduction is that verifying nutrient effluent levels would be too costly to be viable. Direct measurement of water quality would likely be prohibitively expensive. The alternative is to base nutrient trades on hypothetical effluent reductions based on agricultural practices. The effluent weights assigned production practices might be developed from biophysical simulation models that simulate likely environmental outcomes. Such a regulatory basis for nutrient discharge verification would require reliable records of farm management practices. Farmers could be tempted to make white lies in hopes of certifying low nutrient discharge levels. Moreover, the simulation model would have to be robust enough to withstand a legal challenge.

Another potential risk of nutrient trading is that the market for discharge permits fails to operate properly. If the market fails because the pollution problem is cheaply remedied, then there is no cause for concern. But there is cause for concern if the market fails because a) trading ratios set by regulators deter cost-reducing trades or b) farmers opt not to participate, either fearing to “admit” indirectly that they are polluters or else preferring to avoid the legal responsibility to maintain reduced discharges after having sold permits.

The challenges of implementing nutrient trading pale before those of pesticide discharge permit trading, for pesticides come in far more chemical forms. However, the trading of pesticide risk permits is conceivable, based on farm records of input use rather than on actual monitoring of waterways (Swinton and Batie forthcoming). Other thoughtful policy initiatives include substituting crop insurance for pesticidal protection of crops (Feinerman et al. 1992; ACIC 1999).

Greenhouse gas emission trading currently faces a formidable obstacle: No legislation or regulation limits industrial emissions of carbon dioxide. Moreover, the Bush administration
denies that a problem exists (Jehl and Revkin 2001), so Congressional ratification of the Kyoto Protocol is unlikely to occur. If it did, the next step would be to design implementation legislation that permitted trading, and the EPA’s existing sulfur dioxide trade program could serve as a model.

Setting priorities for green payments and watershed TMDLs should involve estimating local benefits if these programs are to be designed cost effectively. However, benefits valuation can be contentious, as illustrated in previous legal battles over survey-based valuation methods (Diamond and Hausman 1994; Hanemann 1994). Battles could easily emerge over the perceived inequity of unequal payments to farmers in different regions for the same environmental services—based on different benefit valuations and different costs of compliance. Fortunately, it appears that green payments will comply with World Trade Organization norms, so long as the payments are direct payments for environmental services without direct links to commodity prices or production levels (Ervin 1999; Hodge 2000; OECD 1997, as cited in Batie 1999).

The other evident constraints to these options are budgetary and political. CRP participation since 1985 has been limited by the mandated maximum acreage, not by the willingness of farmers to participate. Budget constraints are likely to continue to limit set-aside and paid ecosystem services, as well as green payments programs. By contrast, tradable permits tend to draw lightly on the budget after programs get started, although they require adequate staff to monitor compliance.

An effective monitoring system for performance evaluation is central to all of the proposed programs. Although individual farmers’ participation in these programs may be voluntary, tradable permit programs only work if the ceiling on pollution discharges is monitored and enforced, and green payment programs only work if monitoring ensures that the payments buy what Congress intended. Adequate monitoring staff is essential, a necessity recently overlooked at the Natural Resource Conservation Service where personnel has declined as program mandate has grown over the past 15 years (SWCS 2000). In short, both stick and carrot are needed in order to ensure successful environmental policy outcomes (Casey et al. 1999).

3.c. Changes in constraints and incentives needed to achieve needed changes

The major constraints to implementing these policies are budgetary and administrative. The Conservation Reserve Program has established a strong precedent for land set-aside programs; the variants proposed here for habitat preservation would not entail big changes. As with CRP, the main limiting factor will be the acreage and budget voted by Congress.

The tradable permit programs will require legal and administrative innovation. Certain provisions in the Clean Water Act deter trades currently. In order to facilitate nutrient trading, Stephenson et al. (1999) propose two alternatives. One is that nutrients be kept outside the point source National Pollution Discharge Elimination System, so that nonzero levels of discharge can legally be maintained. The other alternative is that the CWA be reformed to permit a) discharge levels that are above zero but maintain water quality, b) establishment of performance standards rather than de facto technology standards, and c) elimination of the backsliding provisions.
Even with these changes in the CWA, establishing and monitoring watershed TMDLs – the prerequisite for any permit program – will require political willpower and the training of many field staff. Their tasks would be to assign appropriate load allocations to nonpoint sources and to verify discharge reductions that are eligible for trades. Next, trading networks will have to be developed for each watershed. The World Resources Institute has established a web site for nutrient trades to illustrate the potential for unbrokered trades at low cost (Faeth 2000). However, experience remains very limited so far.

CONCLUDING REMARKS
4.a. Key leverage points in the commodity system for achieving change
Previous research commissioned by the World Wildlife Fund found that for the corn, soybean and beef cattle commodity systems, the greatest environmental impacts take place during production, not during input manufacture, commodity marketing, consumption or disposal (Runge and Stuart 1997; Schnittker 1997; Conner et al. 1999). Consequently, this position paper has focused on the production process.

In focusing on the agricultural production links in the commodity chain, this paper has tried to identify policies with the potential to make dramatic changes while remaining politically viable. The National Organic Standards Act and other ecolabeling proposals have proven viable largely because they did not change the distribution of property rights (Blend and van Ravenswaay 1999; Nimon and Beghin 1999; Ervin and Casey 2000). But their likelihood of generating major environmental impacts is modest. By contrast, a radical regulatory policy could achieve dramatic changes, but would be infeasible politically. The incentive-based proposals here are attempt to strike a balance between environmental impact and political feasibility. Although focused on the farm, they could well engage other actors in the commodity system, including crop consultants for improved management practices, wildlife biologists for identifying valued species habitat, and futures market traders for tradable discharge permits.

4.b. How to pay for proposed solutions
The three policies proposed here are 1) leased land set-asides and habitat service contracts, 2) green payments for specific environmental outcomes, and 3) tradable permits for nutrients and greenhouse gas emissions. Introducing the second and third categories of policy will require major adjustments to implementing agencies such as USDA and EPA. Making those adjustments will be costly and will demand great political willpower. But it is quite possible that the proposed agro-environmental policies could be implemented with only a modest increase in costs over the combined current federal outlays for agro-environmental and agricultural income support programs. Funds currently allocated for the CRP and related programs could be partially reallocated as proposed here with the potentially greater benefits. Those benefits could flow from shifting some funds to specific native habitat services that do not require total cessation of agricultural production and improving set-aside programs for enhanced native habitat preservation and soil conservation.

The tradable permit proposals for water-borne nutrients and airborne greenhouse gasses would require significant upfront costs to establish baseline permit levels. Once established, the programs should be largely self-sustaining, so long as adequate funds are budgeted for monitoring environmental performance and enforcement of contracts.
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