AIMING FOR THE RIGHT TARGET:  
THE RELATIONSHIP BETWEEN AGRICULTURAL VOLUNTARY INITIATIVES AND WATER QUALITY IMPAIRMENT

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By

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ABSTRACT

Since the 1970s, agriculture has been cited as one of the leading contributors to the nation’s degraded water quality. Forty years after the Clean Water Act’s passage, nonpoint source pollution from agricultural operations remains a persistent policy challenge that cannot viably be addressed through regulatory mechanisms. Accordingly, voluntary, incentive-based programs—whereby farmers receive funding to undertake sustainable agriculture practices that benefit soil, water quality, and wildlife habitat—have gained popularity as a mechanism for addressing the looming nonpoint source problem. Given that funding for federal voluntary initiatives is limited, targeting these funds toward the most pressing geographic areas of resource concern is critical to achieving environmental goals. My research examines the extent to which funding under one of the farm bill’s voluntary initiatives, the Environmental Quality Incentives Program, has been targeted at the most impaired watersheds at the national level. In other words, I examine the extent to which water quality predicts Environmental Quality Incentives Program funding. I find that water quality does not predict funding, indicating that this particular voluntary initiative has not been targeted toward the most impaired watersheds. Accordingly, I recommend that future award allocations be driven by resource impairment, that USDA adopt a “Precision Conservation” model, and that water quality monitoring across the nation be improved.
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Introduction

When the Clean Water Act was passed in 1972, it aimed to restore the integrity of the nation’s waters by controlling the sources of water pollution. Since that time, the Clean Water Act dramatically improved water quality in the U.S. by controlling large and identifiable point sources such as industrial operations and sewage plants, resulting in rapid and demonstrable success.\(^1\) Indeed, as of 1998, states report that that the condition of two-thirds of surface water and three-fourths of groundwater is good.\(^2\) While the gains made in terms of controlling point source pollution are noteworthy, a significant—if not larger—problem is the nonpoint source pollution from less readily identifiable sources.

Since the 1970s, agriculture has been cited as one of the leading contributors to the nation’s degraded water quality.\(^3\) Forty years after the Clean Water Act’s passage, nonpoint source pollution from sources such as agricultural operations and stormwater runoff remains a persistent challenge. With farms and ranches covering about half of the U.S. land base\(^4\)—and about one third of the global land area, typically the most productive lands\(^5\)—agricultural nonpoint source pollution is “the leading source of water quality impacts to rivers and lakes, and a major contributor to groundwater contamination and wetlands degradation.”\(^6\) Across a variety


\(^2\) Ervin, 73.


\(^4\) Ervin, 74.


of water bodies—tributaries, lakes, estuaries, and beyond—degraded water quality can be attributed to agriculture.\(^7\) In 1994, U.S. Geological Survey scientists estimated that “71 percent of U.S. cropland lies in watersheds where at least one agricultural pollutant violates criteria for recreational or ecological health.”\(^8\)

The Gulf of Mexico provides an example of the damages caused by the major agricultural pollutants: nitrogen, phosphorus, and sediment. These pollutants are carried from Corn Belt states down the Mississippi River, where they load into Gulf Coast estuaries. As they do on land, nutrients (nitrogen and phosphorus) encourage the growth of plant life—in an aquatic setting, this means that excessive algal growth occurs, which reduces dissolved oxygen levels, resulting in the death of fish, shellfish, and other aquatic life. This has led to a “Dead Zone” in the Gulf of Mexico several hundred square miles in size.\(^9\) In general, “annual damages caused by sediment runoff alone are estimated at between $2 and $8 billion.”\(^10\)

Addressing the agriculture sector’s pollution through a regulatory mechanism presents numerous technical and political challenges that make it a nonviable policy mechanism for addressing the problem. In addition to the technical and political challenges that characterize nonpoint source pollution, an additional reason that nonpoint source has gone unaddressed is because, while payments for refraining from damaging activities vis-à-vis incentives have been a cornerstone of the U.S. approach to addressing nonpoint source pollution, the agriculture lobby has successfully resisted reform strategies that do not include payments to farmers.\(^11\)

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\(^8\) Ervin, 74.
\(^9\) Ervin, 75.
\(^10\) Ervin, 74.
\(^11\) Ervin, 74.
Accordingly—and as I will discuss at length below—voluntary, incentive-based programs have gained popularity as a mechanism for addressing the looming nonpoint source problem. Under voluntary, incentive-based programs—or “green payments”—farmers receive funding to undertake sustainable agriculture practices that benefit soil, water quality, and wildlife habitat. At the federal level, funding for these programs occurs primarily through the conservation title of the farm bill, the federal government’s primary means of setting agriculture policy, passed every five to seven years. A subset of farm bill conservation title programs—the Conservation Stewardship Program (CSP), Environmental Quality Incentives Program (EQIP), and Wildlife Habitat Incentives Program—focus specifically on changing practices on “working lands” that are actively farmed, rather than set asides or conservation easements.

Approximately “40 percent of U.S. agricultural land—roughly 15 percent of all the land in the United States—is enrolled in farm bill conservation programs aimed at improving soil retention and reducing nutrient pollution.”12 In fiscal year 2012, the cost of the farm bill conservation title was $844 million. Critics of farm bill programs argue that many of these programs are political payments that have not been proven effective.13 It is difficult to prove conservation programs effective in the first place because it is difficult to draw causal linkages between conservation funding and outcomes.

A critical piece of achieving improved conservation outcomes is targeting incentives at the most environmentally impaired ecosystems. This would mean concentrating funding at the spatial scale to address particular geographic areas of resource concern. As interest has grown in measuring the efficacy and outcomes of voluntary, incentive-based farm bill programs, policy

12 Sponberg, 797.
analysts and decision makers must begin by determining whether such voluntary initiatives are, in practice, being targeted at the most impaired watersheds. In a context of limited resources, one would assume that policy makers should explicitly account for the targeting of these limited conservation resources in an effort to maximize positive conservation outcomes, such as improved soil or water quality.

In my research, I examine the relationship between the geographic pattern of conservation title funding (focusing specifically on EQIP) and water quality at the watershed sub-region level. I investigate the extent to which incentive payments have been targeted at the most impaired watersheds. My point of departure is rather simple: if policy makers want to maximize conservation outcomes given limited resources, targeting incentive programs to the most needy resource areas at the national level must become standard practice.

I begin with a broad discussion of the issue of efficacy in voluntary initiatives before discussing the issue of targeting. I then perform multivariate regression analysis to determine the extent to which water quality (in terms of key agricultural pollutants) predicts contract dollar awards under the Environmental Quality Incentives Program at the national, hydrological subregion (HUC-4) level. My models address this question from two perspectives by analyzing the density (total dollars) and intensity (number of contracts) of this voluntary initiative. Results indicate that there is no statistically significant relationship between agricultural pollutants and EQIP dollars awarded, suggesting that this initiative has not historically been targeted at areas of resource concern. I then discuss the limitations of this study and policy recommendations.
Literature Review

Incorporating Ecosystem Service Goals into Agriculture Policy

The problem of nonpoint source pollution, which persists decades after the Clean Water Act’s passage due in no small part to agriculture elicits consideration of which policy areas ought to be included under the rubric of agriculture policy. The scientific community has argued for the merits of a broad agriculture policy that expands the conventional view of agriculture from just a source of food, fiber, biofuels, and renewable energy, to a broader conception that incorporates the delivery of critical ecosystem services such as clean water, carbon sequestration, and wildlife habitat. In other words, this is a call to broaden the framework for agricultural management at the policy level, recognizing that many critical ecosystem services flow from agricultural lands. The fact that ecosystem services are not adequately or formally accounted for on a large scale in U.S. agricultural policy perpetuates the challenges of promoting resource management as a goal alongside productivity.

In terms of structure, many argue that the coordinated management of agricultural lands as landscapes (rather than units ending at property lines) can assist in realizing the benefits stream of ecosystem services. In order to manage for the long-term sustainability of agricultural landscapes, ecosystem services—such as pollination, hydrologic services, and carbon sequestration—must become the focus, and not just food production. Goldman et al. cite the need for increased scientific understanding, new revenue streams, engaging with stakeholders, and coordination as challenges to including broader management goals in agriculture policy.

15 Goldman, Thompson, and Dailey.
The fact that most ecosystem services are public goods presents, perhaps, the foremost institutional barrier for broadening agricultural landscape management goals and for addressing nonpoint source pollution in a more robust manner. Because resources are public goods, private landowners have little incentive to conserve and enhance the ecosystem services that flow from these resources.\textsuperscript{16} Natural resources have a bifurcated benefits stream whereby costs and benefits are created and born by different parties.\textsuperscript{17} For example, farmers polluting water with fertilizer and livestock manure upstream do not suffer the drinking water quality costs that the public might downstream. As Jack, Kousky, and Sims point out, the gaps between private and social benefits illustrate the fact that absent regulatory threat, farmers have little to no incentive to pursue water quality as a land management goal in current markets. Herein lies the dynamic driving ecosystem integrity decline as a result of human pressure, and one that voluntary programs can help to correct.

\textit{Policy Options}

With respect to policy options available for addressing nonpoint source pollution stemming from agriculture, as previously discussed, the regulatory, command-and-control framework does not constitute a viable policy option for nonpoint sources. Nonpoint source pollution is difficult to attribute because it is mobile and diffuse. If, therefore, nonpoint source pollution is to be addressed, it will require an approach that is not command-and-control by design. Blanket regulations to address nonpoint source water pollution would be undesirable and are thought to be ineffective: agricultural water pollution tends to occur where farming is

\textsuperscript{16} Goldman, Thompson, and Dailey.
extensive and fresh water resources are vulnerable, highlighting the need for site-specific approaches, and the unsuitability of a blanket approach.\textsuperscript{18}

The conservation literature suggests that with regard to the privately held land base of the U.S., voluntary (in contrast to command-and-control) programs are not only becoming more prevalent in environmental policy, but offer significant benefits over traditional regulatory approaches.\textsuperscript{19} In evaluating on-farm water conservation and agricultural economic tradeoffs between selected regulatory and conservation-incentive water-policy choices, Schaible finds that conservation-incentive water policy, when integrated with balanced policy reforms, can produce upwards of 1.7 million acre-feet of on-farm conserved water, while also increasing economic returns to farmers.\textsuperscript{20} Further, incentive-based programs are shown to enhance decision-maker flexibility in meeting multiple goals. With respect to adoption, farmers’ willingness to accept is shown to be highest for incentive-based programs, and lowest for traditional command-and-control policies.\textsuperscript{21}

\textit{Understanding Voluntary Approaches to Addressing Resource Problems}

Voluntary programs go by a variety of names: “pay for performance”, “green payments”, and “incentive-based programs” would all fall under the rubric of voluntary programs that exist as an alternative to command-and-control. As Jack, Kousky, and Sims suggest, subsidies and grants or cost-share programs (payments) can be thought of within a broader framework of

\textsuperscript{18} Ervin, 74.
\textsuperscript{21} Schaible, 221.
payments for ecosystem services (PES) policies. An operationalized definition for PES programs is given by Wunder: “A PES scheme, simply stated, is a voluntary, conditional agreement between at least one ‘seller’ and one ‘buyer’ over a well defined environmental service—or land use presumed to produce that service.”

PES schemes range in design in terms of form of payment, providers, services provided, implementers, intermediaries, whether incentives are given at the community or individual level, rules of participation, and source of funding. At their core, PES programs change incentives, rather than rules.

Rather than attempting to mitigate or eliminate environmental harms through regulations or fee structures, payments for ecosystem services proceed from the premise that ecosystems provide a stream of benefits for people, and that the “type, quality, and quantity” of these ecosystem services are affected by the resource use decisions of individuals and communities. Voluntary programs recognize the externality problem, and that private markets do not address the externality and public good problem that characterizes natural resources. Where a command and control regulatory framework imposes requirements and sanctions, incentive-based policies “address externalities by altering the economic incentives private actors face, while allowing those actors to decide whether and how much to change their behavior.”

Incentive-based policies include “charges (such as taxes, user fees, and deposit-refund systems), subsidies, tradable permits (including markets for pollution reduction and tradable development rights), and market friction reduction (e.g. liability rules and information programs).” Because farmers

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23 Jack, Kousky, and Simms. 9466.
24 Jack, Kousky, and Simms. 9466.
26 Jack, Kousky, and Simms. 9465.
27 Jack, Kousky, and Simms. 9465.
who seek to implement best management practices in terms of practicing sustainable agriculture or generating ecosystem services on their land may see a reduction in their income due to the potential costs of implementing these such practices, voluntary initiatives in the form of financial incentives may reduce such adverse financial impacts for farmers.\textsuperscript{28}

\textit{Incentive Design: Getting It Right}

Farm bill conservation title programs are nested within a broader global context of PES public policies targeting landowners in an effort to elicit the generation of desired ecosystem services that gained popularity starting in the 1990s.\textsuperscript{29} In targeting landowners, incentive design matters in the pursuit of ecosystem goals, and no single policy is right for every context. The environmental context matters, as the ecosystem and pollutant in question should drive policy design, and will influence what expectations should be for outcomes.\textsuperscript{30} The example of water quality presents a particular challenge for incentive design, as design becomes increasingly complex when the marginal benefits for an ecosystem from generating ecosystem services are not constant.

In terms of socioeconomic factors, the "greater the heterogeneity in costs, the greater the potential for a PES scheme to be cost-effective compared with a command-and-control approach."\textsuperscript{31} Another way to think about this is that incentives will be more cost-effective when marginal provision costs across the affected population are highly varied.\textsuperscript{32} Transaction costs for

\begin{flushleft}
\textsuperscript{29} Jack, Kousky, and Simms. 9465.
\textsuperscript{30} Jack, Kousky, and Simms. 9466.
\textsuperscript{31} Jack, Kousky, and Simms. 9467.
\textsuperscript{32} Jack, Kousky, and Simms. 9467.
\end{flushleft}
PES will be higher in situations where resources are owned by many small-holders, because contracting and monitoring are cheaper when the number of agents is small. This finding has direct application to the problem of nonpoint source water pollution because monitoring and evaluation of these mobile, diffuse, and hard to identify sources is extremely costly. Flexibility is also important in program design: “Allowing multiple ways to comply with an incentive-based approach will increase resilience to price changes that affect the production of environmental quality.”

Ervin suggests that effective agricultural policy design in the pursuit of environmental objectives would involve setting specific, measurable environmental objectives, such as nitrate or pesticide concentration in drinking water; creating a portfolio of tangible objectives for farmers who generate environmental benefits higher than the minimum; establishing a market for water quality trading; and stimulating improved research and development for monitoring and on-farm technologies.

On a cautionary note, PES schemes may have the dual effect of making it profitable in the long-term to enter or stay in the industry. “By changing prices, incentive-based policies may unintentionally enhance the profitability of an environmentally harmful activity, undermining environmental effectiveness.” Similarly, firms may also manipulate baselines (if abatement is measured with reference to a baseline), in an effort to extract more compensation.

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33 Jack, Kousky, and Simms. 9467.
34 Jack, Kousky, and Simms. 9469.
35 Ervin, 76.
36 Ervin, 77.
37 Ervin, 78.
38 Jack, Kousky, and Simms. 9468.
40 Jack, Kousky, and Simms. 9469.
Jack, Kousky, and Sims also find that incentive-based policies that encourage innovation will be more cost effective over time.41

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**Incentives May Not Be Enough to Sustain Long-Term Behavioral Change**

While incentive-based or PES programs offer a practical tool for addressing nonpoint source pollution where a regulatory path does not, some argue that voluntary programs are not an adequate response given the scale of the nonpoint source pollution. Wu, Adams, Kling, and Tanaka present an empirical model that predicts farmers’ production practices and the resulting levels of agricultural runoffs at more than 42,000 sites in the upper-Mississippi river basin under alternative conservation policies. Their research suggests that in these areas, conservation payments increase the use of conservation practices, but the acreage response is inelastic, and that payment programs are not enough to address, for example, the hypoxia problem in the Gulf of Mexico.42 The authors analyze changes in the adoption of crop rotations from more conventional corn and soy rotations to more of a conservation model under a range of payment levels, finding that conservation payments can increase the use of crop rotations and conservation tillage. In terms of the predictive probability of the authors’ models in explaining the effect of green payments on environmental performance, the models prove less able to explain environmental outcomes than predicting the performance of farmers’ behavior adaptation, due to underlying environmental production functions. This finding highlights the general challenges that exist in quantifying the relationship between incentives and environmental outcomes discussed earlier, as drawing a causal relationship between conservation practices and outcomes can often prove challenging.

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41 Jack, Kousky, and Simms. 9469.
The Environmental Quality Incentives Program—the program of interest for the purposes of my research—seeks to reduce the adverse impacts of agriculture by encouraging farmers, through financial incentives, to adopt improved nutrient management techniques that are likely to improve conservation outcomes. Because differences in farms structure and incentive structure exist, and farmers are unsure of the returns they will see from the adoption of conservation practices, the strength of green payments in terms of environmental performance is likely to vary. It may be the case that the U.S. has done itself a disservice in the long-term by making voluntary incentives a cornerstone of the country’s nonpoint source water pollution management policy, because relying on what amounts to a subsidy program may cause some farmers to expect and rely upon these programs down the line.

Isik finds that uncertainty about the future of subsidy programs may depress overall adoption rates. Isik’s model indicates that uncertainty about green payment and subsidy policy can impact the investment decisions of farmers, specifically that, “cost-share subsidy policies are most effective in inducing technology adoption when they are immediately offered to farmers and guaranteed that they will be removed soon.” Isik also finds that the expectation that a policy will be put into place to fine non-adopters of “site-specific technologies” also drive farmers’ incentives to adopt such technologies.

Institutions Matter: Management Scale as a Barrier to Water Quality Conservation

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43 Isik, 247.
44 Isik, 248.
45 Isik, 258.
46 Isik, 261.
47 Isik, 261.
The literature has long pointed to the role of institutional design as an impediment to reducing agricultural pollution. Sharp and Bromley pointed out in the 1970s that though best management practice technology exists for reducing nonpoint source agricultural loadings, the distance between farmers’ individual actions and water quality impacts present a structural impediment to water quality improvements—a distance that was not appreciated by policy makers at the time. Today’s farm bill conservation programs, then, can be thought of as an effort to bridge that distance, and to correct for the problem of natural resources as public goods.

Today’s incentive programs take a field-level approach by rewarding individual farmers because they operate through individual farmers’ applications, with each farmer being rewarded for practices implemented on his or her own land. By contrast, a landscape-level approach would span property boundaries. The disadvantage of providing incentives at the individual farm unit is that these units do not perfectly align with the ecosystem service in question. While some services such as carbon sequestration may benefit from individual farm-level incentive targeting in the short term, incentives targeted at landscape level goals stand to benefit all classes of ecosystem services.

Measuring Conservation Outcomes: Challenges

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48 Sharp and Bromley, 591.
49 Sharp and Bromley, 598.
51 Goldman, Thompson, and Dailey, 5.
Quantifying conservation outcomes presents a host of obstacles. Jack, Kousky, and Sims point out that “measuring the environmental effects of a policy can sometimes be impossible or prohibitively expensive.” For this reason, PES schemes will often rely upon more readily countable or observable proxies such as “the presence of buffer strips or the amount of forest cover” in order to examine the efficacy of incentive-based programs. In a water-specific context, the relationship between farm inputs such as fertilizer and pesticides—and thereby reductions in those inputs that might result from a policy—and water quality is not well understood, making behavioral mandates an ineffective solution.

Because the relationship between inputs and outcomes is not well understood, it follows that gathering data and modeling will be challenging as well. With respect to data, Ervin reports that national data on groundwater quality are scarce “because of the difficulty and cost of monitoring.” Various models have been developed to estimate nonpoint source pollution loading for use on a landscape scale and for conservation strategy development. Pollution load estimate models, however, have been shown to sometimes deliver inaccurate estimates for some portion rivers, under certain timeframes, and at local scales.

Inroads have been made into monitoring and evaluation of farm bill programs. The Conservation Effects Assessment Project (CEAP) “was initiated by the Natural Resources Conservation Service, the Agricultural Research Service (ARS), and Cooperative State Research, Conservation Service, the Agricultural Research Service (ARS), and Cooperative State Research, Conservation Service, the Agricultural Research Service (ARS), and Cooperative State Research, Conservation Service, the Agricultural Research Service (ARS), and Cooperative State Research,”

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52 Jack, Kousky, and Simms. 9467.
53 Jack, Kousky, and Simms. 9467.
54 Ervin, 74.
55 Ervin, 74.
Education, and Extension Service (CSREES) in response to a general call for better accountability of how society would benefit from the 2002 farm bill’s substantial increase in conservation program funding. In its first five years, CEAP undertook research and assessment efforts of conservation practices through research, data, model development, and model application. CEAP’s watershed assessment studies were undertaken to quantify measurable effects of conservation practices at the watershed scale. Projects include watershed benchmark studies to quantify the measurable effects of conservation practices on the quality or quantity of water and soils, a data storage and management system, and a modeling system.

As CEAP’s work highlights, efforts have been undertaken to quantify the relationship between conservation practices and outcomes, but a gap in the literature exists in examining the relationship between funding patterns in incentive programs and resource impairment. In my research, I examine the issue of funding patterns and resource concerns, specifically whether Environmental Incentives Quality Program dollars have been deployed in a targeted fashion to the watersheds across the country that are most in need.

**Criticism of the Current Conservation Model**

The dominant voluntary conservation initiative model in the U.S. has been criticized on the grounds that is constitutes “random acts of conservation”: that incentives are not deployed in a targeted way that prioritizes environmentally impaired areas. Others have criticized the

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59 Duriancik, 197A.

current pattern of conservation incentive programs in agriculture as an overall policy of aggregation, which assumes that positive conservation outcomes will necessarily follow from the existence of conservation programs across the landscape.\textsuperscript{61} Such assumptions do not account for the importance of operating with limited resources: without giving thought to the strategic targeting of such incentives, funding is not being deployed in pattern that maximizes improvement in conservation outcomes (in terms of, for example, improved soil or water quality). Scholars have called for better use of targeting in incentive programs, arguing that concentration efforts must be directed at appropriate targets.\textsuperscript{62} Incorporating targeting into funding patterns in not impossible: some scholars hold that that the tools to employ effective targeting practices—such as surface modeling, spatial data mining and map analysis—exist and need only be incorporated into the process of awarding incentive-based payments, in order to undertake “precision conservation”.\textsuperscript{63}

As noted above, if we assume that policy makers should aim to achieve the most conservation good possible given limited resourced, explicit attention must be paid to the issue of targeting. My research examines the extent to which voluntary initiative dollars have, if at all, been targeted at the most impaired watersheds. While scholarly criticism has focused on a general need for voluntary initiatives to be more targeted in order to achieve more environmentally efficacious outcomes, little is known about the extent to which funding has

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matched water quality impairment at the national level. A more precise understanding of this will help to inform any targeting efforts undertaken in the future. Accordingly, my research seeks to address this very gap in the literature: to what extent have voluntary initiatives reached watersheds with higher levels of impairment?
Data and Methodology

As my research examines the relationship between voluntary initiative funding patterns and water quality at the watershed sub-region level, data were gathered for each of these measures, as well as two additional factors that may influence funding patterns and/or water quality. With respect to scale, the U.S. is divided and sub-divided into “successively smaller hydrologic units which are classified into four levels: regions, sub-regions, accounting units, and cataloging units.”64 Each of these units are identified by a hydrologic unit code (HUC) consisting of two to eight digits based on the four levels of classification in the hydrologic unit system. My analysis was performed at the aggregated HUC-4 level, which represents the sub-region level. Water sampling was conducted at a smaller geographical scale, but my research aggregated water samples to the HUC-4 level in order to better match contract awards to water quality information. As discussed earlier, inadequate monitoring and data limitations present a challenge for evaluating the efficacy of both targeting and conservation outcomes. Confronting these data limitations in my research, I was constrained to a relatively small sample size (55 observations) due to the limited parity between water quality monitoring data and farm bill conservation title dollars data.

Data on voluntary initiatives funding represent the Environmental Quality Incentives Program (discussed in the Introduction) from 2002-2011, and are comprised of both the number of contracts (awards) and total dollar amount obligated at various sub-region levels throughout the country. The data represent dollars obligated under the conservation title of the farm bill, and were obtained by request from the United States Department of Agriculture’s Resource Economics, Analysis and Policy Division of the Natural Resources Conservation Service. The

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Natural Resources Conservation Service is responsible for implementation of farm bill conservation title funding administration, and accordingly is the division that tracks farm bill contract awards to the nation’s farmers. While dollars obligated represent the overall intensity of funding, the number of contracts awarded represents the density of contracts in a given geographical area, providing insight into both regions of the country that are receiving higher levels of overall conservation dollars, and regions of the country that have a higher concentration of farmers in a given geographic area who are enrolled in farm bill contract awards.

Table 1. Descriptive Statistics Without Regional Indicator Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observations</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Min.</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract Obligations (in hundreds of thousands of dollars)</td>
<td>55</td>
<td>266.189</td>
<td>167.266</td>
<td>14.551</td>
<td>859.130</td>
</tr>
<tr>
<td>Contract Count</td>
<td>55</td>
<td>1721.491</td>
<td>1187.322</td>
<td>102</td>
<td>4825</td>
</tr>
<tr>
<td>NO2_NO3 (nitrogen in mg/L)</td>
<td>55</td>
<td>.779</td>
<td>.961</td>
<td>.035</td>
<td>5.185</td>
</tr>
<tr>
<td>TP (total phosphorus in mg/L)</td>
<td>55</td>
<td>.182</td>
<td>.279</td>
<td>.009</td>
<td>1.615</td>
</tr>
<tr>
<td>Region’s Primary Governor Political Party 2002</td>
<td>55</td>
<td>.164</td>
<td>.373</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Priority Ecosystem for Obama Administration</td>
<td>55</td>
<td>.509</td>
<td>.505</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

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65 USDA Natural Resources Conservation Service.
66 USDA Natural Resources Conservation Service.
69 National Governors Association.
70 White House Council on Environmental Quality.
Table 2. Descriptive Statistics of Regional Dummy Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observations</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Min.</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>55</td>
<td>0.091</td>
<td>0.290</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Southeast</td>
<td>55</td>
<td>0.218</td>
<td>0.417</td>
<td>0</td>
<td>1</td>
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<tr>
<td>South</td>
<td>55</td>
<td>0.127</td>
<td>0.336</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Midwest</td>
<td>55</td>
<td>0.291</td>
<td>0.458</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>West</td>
<td>55</td>
<td>0.182</td>
<td>0.389</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Southwest</td>
<td>55</td>
<td>0.109</td>
<td>0.317</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

The mean contract dollar amount for each watershed sub-region was $266,189,000, with a standard deviation of $167,266,000, a minimum value of $14,551,000, and a maximum value of $859,130,000 per subregion. The mean number of contracts awarded per watershed sub-region was 1721, with a standard deviation of 1187, a minimum value of 102, and a maximum value of 4825.

With respect to water quality measures, data for the two primary agricultural nutrient pollutants—nitrogen/nitrite and total phosphorus—were used. The data were drawn from the *Nutrients in the Nation’s Streams and Groundwater: 1992-2001* dataset, a water quality study conducted in agricultural watersheds throughout the nation by David K. Mueller and Norman Spahr, and made available by the United States Geological Survey. For measures of nutrient pollution in groundwater across the nation (limited to years 1997-2001), we see an average of 0.779 milligrams of nitrogen/nitrite per liter, with a standard deviation of 0.961 milligrams per liter, a minimum value of 0.035, and a maximum value of 5.185. In terms of total phosphorus, we see
an average of .182 milligrams of total phosphorus per liter, with a standard deviation of .279 milligrams per liter, a minimum value of .009, and a maximum value of 1.615.

In addition to water quality factors, I incorporated two other factors that may influence the pattern of voluntary initiative funding throughout the nation. The first factor was the primary political party of the governor of the states captured by a watershed sub-region, data obtained from the National Governor’s Association, a dummy variable with 1 representing Democratic governorship, and 0 representing Republican Governorship. This is because such a measure is likely to proxy for conservation activity participation rates, and outreach to state conservation districts. We see that primary governorship skews toward Republican.

In addition to political party, a dummy variable was used for watershed sub-regions that are part of the Obama Administration’s list of priority ecosystems, information obtained by interviews with the White House Council on Environmental Quality. These ecosystems include the Chesapeake Bay, Everglades, California Bay Delta, Gulf of Mexico, and Great Lakes. This information proxies both for watersheds throughout the nation that have historically been the most impaired and most in need of conservation intervention, as well as watersheds that represent relatively levels of nongovernmental organization activity. We see here that the nation is fairly evenly split, with about half of watershed sub-regions falling into one of these priority ecosystems, and the other half not.

Regional indicator variables were generated, representing whether a given HUC was located in the Northeast, Southeast, South, Midwest, or West (no observations were present in the data that were located in the Northwest, California, Alaska, or Hawaii).
Table 3. Correlation Coefficients *Without* Regional Indicator Variables

<table>
<thead>
<tr>
<th></th>
<th>NO2_NO3 (nitrogen in mg/L)</th>
<th>TP (total phosphorus in mg/L)</th>
<th>Region’s Primary Governor Political Party 2002</th>
<th>Priority Ecosystem for Obama Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO2_NO3 (nitrogen in mg/L of water)</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TP (total phosphorus in mg/L of water)</td>
<td>0.584</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region’s Primary Governor Political Party 2002</td>
<td>-0.087</td>
<td>-0.219</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Priority Ecosystem for Obama Administration</td>
<td>0.041</td>
<td>0.046</td>
<td>0.434</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Correlation coefficients run without including regional dummy variables do not show evidence of high correlation between independent variables.
Table 4. Correlation Coefficients With Regional Indicator Variables

<table>
<thead>
<tr>
<th>Region’s Primary Governor or Political Party 2002</th>
<th>NO2_N (nitrogen in mg/L)</th>
<th>NO2_N (nitrogen in mg/L of water)</th>
<th>TP (total phosphorus in mg/L)</th>
<th>TP (total phosphorus in mg/L of water)</th>
<th>Region’s Primary Governor or Political Party 2002</th>
<th>Priority Ecosystem for Obama Administration</th>
<th>North East</th>
<th>South East</th>
<th>South</th>
<th>Midwest</th>
<th>West</th>
<th>Southwest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority Ecosystem for Obama Administration</td>
<td>0.041</td>
<td>0.046</td>
<td>0.434</td>
<td>1.000</td>
<td>Priority Ecosystem for Obama Administration</td>
<td>Priority Ecosystem for Obama Administration</td>
<td>North East</td>
<td>South East</td>
<td>South</td>
<td>Midwest</td>
<td>West</td>
<td>Southwest</td>
</tr>
<tr>
<td>North East</td>
<td>-0.063</td>
<td>-0.061</td>
<td>-0.14</td>
<td>-0.196</td>
<td>North East</td>
<td>North East</td>
<td>South East</td>
<td>South</td>
<td>Midwest</td>
<td>West</td>
<td>Southwest</td>
<td></td>
</tr>
<tr>
<td>South East</td>
<td>-0.003</td>
<td>-0.108</td>
<td>0.837</td>
<td>0.519</td>
<td>South East</td>
<td>South East</td>
<td>South East</td>
<td>South</td>
<td>Midwest</td>
<td>West</td>
<td>Southwest</td>
<td></td>
</tr>
<tr>
<td>South</td>
<td>0.278</td>
<td>0.168</td>
<td>-0.169</td>
<td>-0.389</td>
<td>South</td>
<td>South</td>
<td>South East</td>
<td>South</td>
<td>Midwest</td>
<td>West</td>
<td>Southwest</td>
<td></td>
</tr>
<tr>
<td>Midwest</td>
<td>0.007</td>
<td>0.136</td>
<td>-0.283</td>
<td>0.549</td>
<td>Midwest</td>
<td>Midwest</td>
<td>South East</td>
<td>South</td>
<td>Midwest</td>
<td>West</td>
<td>Southwest</td>
<td></td>
</tr>
<tr>
<td>West</td>
<td>-0.13</td>
<td>-0.039</td>
<td>-0.209</td>
<td>-0.480</td>
<td>West</td>
<td>West</td>
<td>South East</td>
<td>South</td>
<td>Midwest</td>
<td>West</td>
<td>Southwest</td>
<td></td>
</tr>
<tr>
<td>Southwest</td>
<td>-0.126</td>
<td>-0.167</td>
<td>-0.155</td>
<td>-0.0356</td>
<td>Southwest</td>
<td>Southwest</td>
<td>South East</td>
<td>South</td>
<td>Midwest</td>
<td>West</td>
<td>Southwest</td>
<td></td>
</tr>
</tbody>
</table>

Correlation coefficients run with regional dummy variables included suggest that there is high correlation between Southeast and priority ecosystem, Midwest and priority ecosystem, and Southeast and the primary political party of regional governors. This is not surprising, because the overwhelming majority of priority ecosystems under the Obama administration are located in
either the Southeast or Midwest, and we would expect the South to correlate highly with Republican Governorships.
Results

Multiple regression models were run to determine the extent to which the farm bills’ Environmental Quality Incentives Program contract awards were predicted by water impairment at the HUC-4 level. The conservation dollars variable was transformed by logging the variable. As an additional representation of the spatial dispersion of conservation dollars, I looked at the density of contract awards, and the extent to which the number of EQIP dollars awarded was driven by water quality.

Model 1: Conservation Dollars Logged

\[ \ln(\text{Conservation\ Dollars}) = \beta_0 + \beta_1 \text{NO}_2\_\text{NO}_3 + \beta_2 \text{TP} + \beta_3 \text{Governor\ Party}_3 + \beta_4 \text{Priority\ Ecosystem}_4 + \varepsilon_i \]

|                     | Coefficient | Robust Std. Errors | T     | P>|t| | [95% Conf. Interval] |
|---------------------|-------------|--------------------|-------|------|---------------------|
| NO2\_NO3 (nitrogen in mg/L of water) | -0.045 | 0.12 | -0.37 | 0.710 | -0.285 0.196 |
| TP (total phosphorus in mg/L of water) | 0.212 | 0.342 | 0.62 | 0.538 | -0.475 0.899 |
| Region’s Primary Governor Political Party 2002 | 0.421 | 0.268 | 1.57 | 0.124 | -0.119 0.961 |
| Priority Ecosystem for Obama Administration | -0.300 | 0.251 | -1.20 | 0.237 | -0.805 0.204 |
| Constant | 5.443 | 0.168 | 32.4 | 0.00 | 5.107 5.781 |
| \( R^2 \) | 0.047 |
| Sample Size | 55 |
The first model, which regresses logged EQIP contract dollars on agricultural pollutants, primary political party of regional governors, and whether the region was a priority ecosystem, is not statistically significant overall, and the model explains only about five percent of the variation in conservation dollars (in hundreds of thousands of dollars). None of the independent variables reach statistical significance.

**Model 2: Conservation Contracts Density**

\[
\text{ContractQuantity} = \beta_0 + \beta_1 \text{NO}_2 \text{- NO}_3 + \beta_2 \text{TP} + \beta_3 \text{GovernorParty} + \beta_4 \text{PriorityEcosystem} + \epsilon_i
\]

| Coefficient | Robust Std. Errors | T  | P>|t| | [95% Conf. Interval] |
|-------------|--------------------|----|-------|----------------------|
| NO\_2\_NO\_3 (nitrogen in mg/L of water) | -102.473 | 176.02 | -0.58 | 0.563 | -456.019 251.073 |
| TP (total phosphorus in mg/L of water) | 683.686 | 577.43 | 1.18 | 0.242 | -476.12 1843.487 |
| Region’s Primary Governor Political Party 2002 | 1193.312 | 478.609 | 2.49 | 0.016 | 231.9976 2154.626 |
| Priority Ecosystem for Obama Administration | -83.501 | 329.036 | -0.25 | 0.801 | -744.34 577.388 |
| Constant | 1524.366 | 285.636 | 5.34 | 0.000 | 950.649 2098.083 |

The third model, which regresses contract **density** (the number of conservation contracts) on agricultural pollutants, primary political party of regional governors, and whether the region was a priority ecosystem, is not statistically significant overall, and the model explains only
about 13 percent of the variation in contract density. The political party variable reaches significance at the five percent level, indicating that HUC-4s in regions governed primarily by Democrats receive 1193 more contracts, on average, and holding all else equal, than do HUC-4s in regions governed primarily by Republicans.

**Model 3: Conservation Dollars (Logged) with Regional Indicator Variables Included**

\[
\ln(\text{ConservationDollars}) = \beta_0 + \beta_1 \text{NO2\_NO3} + \beta_2 \text{TP} + \beta_3 \text{GovernorParty}_3 + \beta_4 \text{PriorityEcosystem}_4 + \beta_5 \text{Northeast}_5 + \beta_6 \text{Southeast}_6 + \beta_7 \text{South}_7 + \beta_8 \text{Midwest}_8 + \beta_9 \text{West}_9 + \beta_{10} \text{Southwest}_10 + \epsilon_i
\]

| Coefficient | Std. Error | Z  | P>|z| | [95% Conf. Interval] |
|-------------|------------|----|--------|----------------------|
| NO2\_NO3 (nitrogen in mg/L of water) | -0.131 | 0.126 | -1.04 | 0.304 | -0.385 0.123 |
| TP (total phosphorus in mg/L of water) | 0.126 | 0.438 | 0.29 | 0.775 | -0.757 1.009 |
| Region’s Primary Governor Political Party 2002 | 0.03 | 0.477 | -0.06 | 0.950 | -0.992 0.932 |
| Priority Ecosystem for Obama Administration | 1.331 | 0.780 | 1.71 | 0.095 | -0.241 2.904 |
| Northeast | 0.586 | 1.031 | 0.57 | 0.573 | -1.492 2.664 |
| Southeast | -0.032 | 0.853 | -0.04 | 0.971 | -1.750 1.687 |
| South | 1.691 | 1.121 | 1.51 | 0.139 | -0.569 3.950 |
| Midwest | -0.583 | 0.734 | -0.79 | 0.431 | -2.062 0.857 |
| West | 1.458 | 1.067 | 1.37 | 0.177 | -0.682 3.6 |
| Southwest | 0.582 | 1.129 | 0.52 | 0.608 | -1.692 2.857 |
| Constant | 4.349 | 1.094 | 3.98 | 0.00 | 2.145 6.553 |

Adjusted $R^2$ 0.137

Sample Size 55
The third model, which regresses logged EQIP contract dollars on agricultural pollutants, primary political party of regional governors, whether the region was a priority ecosystem, as well as a series of regional variables is now statistically significant at the 10 percent (but not five percent) level, though the model explains only 14 percent of the variation in conservation dollars (in hundreds of thousands of dollars). The priority ecosystem variable now reaches statistical significance at the 10 percent (but not five percent) level, indicating that regions that are priority ecosystems under the Obama Administration received 133 percent more conservation dollars than areas that are not priority ecosystems under the Obama Administration. None of the other independent variables reach statistical significance.

Model 4: Conservation Contract Density with Regional Indicator Variables Included

\[
\text{ContractQuantity} = \beta_0 + \beta_1 \text{NO2\_NO3}_1 + \beta_2 \text{TP}_2 + \beta_3 \text{GovernorParty}_3 + \\
\beta_4 \text{PriorityEcosystem}_4 + \beta_5 \text{Northeast}_5 + \beta_6 \text{Southeast}_6 + \beta_7 \text{South}_7 + \beta_8 \text{Midwest}_8 + \beta_9 \text{West}_9 + \beta_{10} \text{Southwest}_{10} + \epsilon_i
\]

|                      | Coefficient | Std. Error | Z     | P>|z|  | [95% Conf. Interval] |
|----------------------|-------------|------------|-------|------|---------------------|
| NO2\_NO3 (nitrogen in mg/L of water) | -353.375    | 162.597    | -2.17 | 0.035 | [-681.078, -25.682] |
| TP (total phosphorus in mg/L of water) | 511.327     | 564.566    | 0.91  | 0.370 | [-626.481, 1649.135] |
| Region's Primary Governor Political Party 2002 | 98.488      | 615.338    | 0.16  | 0.874 | [-1141.644, 1338.62] |
| Priority Ecosystem for Obama Administration | 2123.324    | 1005.659   | 2.11  | 0.040 | [96.552, 4150.097]  |
| Northeast | 732.5901 | 1329.256 | 0.55  | 0.584 | [-1946.348, 3411.53] |
| Southeast | 601.855  | 1099.358 | 0.55  | 0.587 | [-1613.754, 2817.465] |
The fourth model, which regresses density (the number of conservation contracts) on agricultural pollutants, primary political party of regional governors, whether the region was a priority ecosystem, as well as a series of regional variables is now statistically significant at the one percent level, and the model explains 43 percent of the variation in contract density. The nitrogen variable is now significant at the five percent level, but the coefficient on the variable is the opposite of what would be expected: for each mg/L increase in nitrogen, a HUC-4 receives approximately 353 fewer conservation contracts. The priority ecosystem variable reaches statistical significance at the five percent level, indicating that regions that are priority ecosystems under the Obama Administration received approximately 2123 more contracts than areas that are not priority ecosystems under the Obama Administration. The south variable is statistically significant at the five percent level, indicating that HUC-4s located in the southern region receive approximately 3423 more contracts on average, all else equal. None of the other independent variables reach statistical significance.

<table>
<thead>
<tr>
<th>Region</th>
<th>Density 1</th>
<th>Density 2</th>
<th>Density 3</th>
<th>Density 4</th>
<th>Density 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>South</td>
<td>3428.67</td>
<td>1445.23</td>
<td>2.37</td>
<td>0.022</td>
<td>516.001</td>
</tr>
<tr>
<td>Midwest</td>
<td>-640.379</td>
<td>945.912</td>
<td>-0.68</td>
<td>0.502</td>
<td>-2546.74</td>
</tr>
<tr>
<td>West</td>
<td>1691.168</td>
<td>1368.592</td>
<td>1.24</td>
<td>0.223</td>
<td>-1067.049</td>
</tr>
<tr>
<td>Southwest</td>
<td>772.305</td>
<td>1454.937</td>
<td>-0.02</td>
<td>0.598</td>
<td>-2158.929</td>
</tr>
<tr>
<td>Constant</td>
<td>-32.997</td>
<td>1409.76</td>
<td>-0.02</td>
<td>0.981</td>
<td>-2874.181</td>
</tr>
</tbody>
</table>

Adjusted R²: 0.433

Sample Size: 55
Model 5: Poisson Model Using Conservation Dollars (Logged)

\[ \ln(\text{ConservationDollars}) = \beta_0 + \beta_1 \text{NO2\_NO3}_1 + \beta_2 \text{TP}_2 + \beta_3 \text{GovernorParty}_3 + \beta_4 \text{PriorityEcosystem}_4 + \epsilon_i \]

|                          | Coefficient | Std. Error | Z      | P>|z|    | [95% Conf. Interval] |
|--------------------------|-------------|------------|--------|--------|---------------------|
| NO2\_NO3 (nitrogen in mg/L of water) | -0.025      | 0.08       | -0.31  | 0.758  | -0.181  0.132      |
| TP (total phosphorus in mg/L of water) | 0.027       | 0.28       | 0.10   | 0.924  | 0.521  0.574       |
| Region’s Primary Governor Political Party 2002 | -0.004      | 0.293      | -0.01  | 0.989  | -0.578  0.569      |
| Priority Ecosystem for Obama Administration | 0.243       | 0.466      | 0.52   | 0.602  | -0.67   1.156      |
| Northeast                | 0.105       | 0.628      | 0.17   | 0.867  | -1.125  1.335      |
| Southeast                | -0.002      | 0.534      | -0.00  | 0.997  | -1.048  1.044      |
| South                    | 0.310       | 0.686      | 0.45   | 0.651  | -1.035  1.655      |
| Midwest                  | -0.106      | 0.461      | -0.23  | 0.818  | -1.01   0.797      |
| West                     | 0.269       | 0.651      | 0.41   | 0.679  | -1.008  1.546      |
| Southwest                | 0.105       | 0.695      | 0.15   | 0.880  | -1.258  1.467      |
| Constant                 | 1.49        | 0.671      | 0.222  | 0.026  | 0.176   2.804      |

Pseudo R\(^2\) 0.008

Sample Size 55

The fifth model uses a poisson model, regressing EQIP conservation dollars on agricultural pollutants, primary political party of regional governors, whether the region was a priority ecosystem, as well as a series of regional variables. The model’s pseudo R-squared is low at 0.008. None of the independent variables reach statistical significance.
The sixth model uses a poisson model, regressing contract density on agricultural pollutants, primary political party of regional governors, whether the region was a priority ecosystem, as well as a series of regional variables. The model’s explains about half of the variation in contract density, with a pseudo R-squared of 0.532. Each of the independent variables is statistically significant.
Holding all else equal: for each mg/L increase in nitrogen, a HUC-4 receives approximately 0.208 fewer conservation contracts on average; for each mg/L increase in total phosphorus, a HUC-4 receives 0.422 more contracts on average; regions that have primarily Democratic governors receive .083 more contracts than those governed primarily by Republicans on average; and regions that are priority ecosystems under the Obama administration receive 1.562 more contracts on average.
Conclusions

The results of the above regression analyses largely fail to reach statistical significance, indicating that, controlling for political party, and priority ecosystems (and regional variables in some models), EQIP conservation dollars have historically not been geographically dispersed at the national level in a manner that reflects water quality impairment at the HUC-4 level. In other words, analysis reveals that water quality in terms of nutrient pollution have not historically constituted a key driver in the awarding of voluntary initiative dollars to farmers, as there is little evidence throughout different models of a statistically significant relationship between water quality and total EQIP dollars.

While both the models and the nutrient pollutant variables failed to reach significance for the models that regressed aggregate conservation dollars on the set of independent variables, the poisson model that regressed conservation contract density (number of contracts) on the set of independent variables showed that all coefficients were highly statistically significant (p<0%). It should be noted that while coefficients were statistically significant, the effect of water quality indicators on the number of contracts awarded was extremely small.

Although the effect of nutrient pollution on contract density was extremely small, this may provide evidence that while overall funding is not driven by water quality impairment—which would ideally be a core driver for voluntary initiatives are used as conservation tools—farms in more impaired watersheds at the national level show higher levels of engagement with their state conservation district officers than farmers in less impaired watersheds. Conversely, this may provide evidence that conservation district officers working in more impaired watersheds are more proactive, and are more likely to approach farmers in their districts and
encourage them to apply for EQIP funding in order to undertake sustainable agriculture practices.

The results of my analysis underscore the critique that some have made of the dominant federal voluntary conservation initiative model as a “conservation policy of aggregation”, which assumes that if enough conservation practices on the landscape, that an overall state of conservation will be achieved”.71 Others refer to this model as “random acts of conservation”72, whereby conservation dollars fail to be allocated with respect to addressing resource impairment at the national level. In order to leverage voluntary initiatives to combat the environmental externalities arising from agriculture, conservation dollars must be obligated with respect to resource impairment concerns at the national level.

The results of my analysis support the existing critique that federal voluntary initiative dollars under EQIP are not dispersed in as targeted a fashion as they should be to effectively address resource impairment issues. A more targeted model of dispersing voluntary initiatives would put resource quality data at the center of award decisions. In the following sections, I discuss the limitations of my study, and my recommendations in light of these findings for more effectively targeting EQIP voluntary initiative dollars.

**Limitations**

It is important to note that the results of this analysis are difficult to generalize and extrapolate for a number of reasons. First, due to limited data availability in watershed sub-basins that had nutrient pollution and conservation dollars measures, the sample size was quite small (n=55). Second, the limited geographic breadth of reliable nutrient pollution measures at

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71 Nowak 2009
72 Knight 2005
the national level constrained the picture that this analysis provides. In other words, more water quality data at the national level would help to provide a fuller picture of the relationship between nutrient pollution and contract award patterns. These two limitations make any generalization about targeting of voluntary initiatives at the national level difficult to undertake.

A final limitation is found in the fact that this analysis only addressed the Environmental Quality Incentives Program. This was in part due to this scope of the research: I sought to examine the ways that working lands farm bill programs (as opposed to conservation easements and set asides) were awarded. Other working lands programs do exist, such as the Wildlife Habitat Incentives Program and the Conservation Stewardship program. However, due to data limitations, EQIP was the only program for which data were available dating back to 2002. Because each of the working lands programs prioritizes different suites of conservation activities, any conclusions from this analysis of EQIP cannot be extrapolated to account for trends in other voluntary initiative programs.

**Recommendations**

*Resource Impairment Should Drive EQIP Award Allocations*

Though the above limitations of this research are important in considering broader policy implications, minimally, this analysis suggests that resources available under the Environmental Quality Incentives Program—the largest federal voluntary initiative—are not being dispersed in a manner that strategically addresses water quality impairment, one of agriculture’s most pressing environmental externalities.

As discussed at the outset, voluntary initiatives can be deployed to address resource impairment, bridging the gap between the conservation measures that farmers can afford to
undertake and those that must be undertaken to mitigate resource impairment. However, as discussed above, without clearly targeting particular resource concerns, voluntary initiatives risk being dispersed in a manner that some have called “random acts of conservation”, wherein voluntary initiatives are not targeted in accordance with resource needs. In order to leverage the financial resources available under the Environmental Quality Incentives Program as tools to mitigate water quality impairment, disbursement of these voluntary initiatives must be determined in accordance with water quality impairment across the nation.

In order to better target water impairment resulting from agriculture as my findings suggest is necessary, I recommend that the U.S. Department of Agriculture prioritize the extent of resource impairment in a given hydrological unit as a core driver in deciding where to award EQIP dollars. To achieve this broader goal, I recommend that USDA adopt a “precision conservation” model with respect to EQIP and improve the overall accessibility of water quality data.

**USDA Should Adopt a “Precision Conservation” Model**

Agriculture is one of the largest sources of nonpoint source water pollution at the national level. As discussed earlier, voluntary conservation initiatives present a useful tool for mitigating this problem. My findings suggest that EQIP dollars have been dispersed in a manner that is not nationally strategic with respect to resource USDA should implement a “precision conservation” model with respect to EQIP.73 Historically, EQIP dollars have been obligated with an eye toward local resource concerns, allowing states significant discretion in awarding contracts.

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While this approach may have provided local benefits, it fails to maximize benefits at the national level by prioritizing more impaired watersheds. A precision conservation model, by contrast, would utilize technologies and procedures to bridge the gap between resource conditions and appropriate management actions.  

By adopting a precision conservation approach to allocating voluntary initiative dollars, I would anticipate that the policy makers would begin to see more “bang” for their conservation “buck” in terms of water quality improvements. Under a precision conservation approach, limited conservation resources would be more concentrated, presumably generating greater outcomes in discrete geographic areas as a result of more focused financing, rather the more diffused outcomes that arise under a “random acts of conservation” approach. In essence, a precision conservation model would make limited dollars go farther.

One important element of focusing in on more resource impaired geographic regions at the national level will involve outreach to farmers in the most impaired watersheds. Historically, the allocation of EQIP dollars has largely been driven by which farmers happen to apply for EQIP dollars, with resource concerns prioritized to a larger extent at the local—versus national—level. In order to prioritize resource-impaired regions, USDA staff should reach out to farmers in the most impaired watersheds. Rather than waiting for farmers in these areas to approach local USDA in their regions, USDA staff should reach out to farmers in these regions in increase application levels in impaired regions.

*Improve water quality monitoring*

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The above recommendations cannot be carried out without a water quality data being made more abundant and more available. The limitations that emerged throughout this research project with respect to water quality data appropriate for looking at agricultural pollution are emblematic of the broader need for improving the scope and availability of nonpoint source water pollution monitoring. Because nonpoint source presents the most persistent and vexing source of water pollution today, solutions to this problem will depend on the quality and quantity of data available. The availability of water quality data simply does not match the scope of the water quality problems that exist across the nation.

Much of the nonpoint source water pollution data available today is highly varied at the site-level, as some watersheds and states have more consistent water quality data available. Accordingly, programmatic assessments are extremely difficult to carry out in a conclusive manner. EPA’s Water Quality Assessment and Total Maximum Daily Loads Information database, for example, provides nonpoint source water quality data by state. While geographically extensive, it is not possible to compare water quality conditions between states or determine water quality trends because of differences in state assessment methods.\(^75\)

The quality and quantity of water quality monitoring at a national scale must be improved. Without data on nonpoint source pollution at the national level that is methodologically consistent, it will be impossible to evaluate the either the effect of voluntary initiatives on conservation outcomes in the future, or—as my research has sought to address—improve how such initiatives are targeted.

Works Cited


