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Does institutional location matter? The effect of agency type on resource distribution for nonpoint water pollution

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ABSTRACT

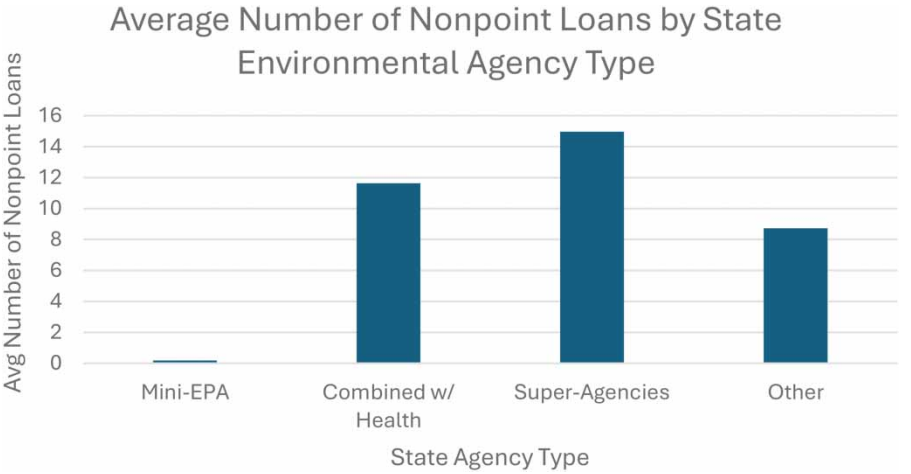
With the rejuvenated emphasis on nonpoint pollution under the Water Quality Act (WQA) of 1987, states seek ways to address nonpoint pollution sources. States can use Clean Water State Revolving Funds (CWSRF) to address nonpoint needs; these funds are administered by state agencies, and funding decisions are typically made by agency personnel. While some states have aggressively funded nonpoint projects, other states have been much more reticent. Moreover, states have created different administrative structures to administer these funds. Does the nature of the structure impact the distribution of loans? Utilizing a dataset spanning state-level data from 1988 to 2016, we test a novel negative binomial cross-sectional time-series model employing the number of CWSRF loans directed to nonpoint projects as the dependent variable. We find that states where water quality management is buried within a 'mini-EPA' agency are the least likely to allocate CWSRF loans for nonpoint source issues, whereas states with 'super' agencies or combined environmental/health agencies allocate a higher number of CWSRF loans to nonpoint source projects.

Key words: Implementation structure, Nonpoint water pollution, State comparative policy, State environmental agencies, State policy choice

HIGHLIGHTS

- The institutional location of the implementing structure is a significant predictor of at state's willingness to direct resources to nonpoint pollution.
- 'Mini-EPA' agencies with a focus on water regulation are less likely to address nonpoint pollution.
- Political factors are generally not significant predictors of state choice in nonpoint pollution policy.

GRAPHICAL ABSTRACT



INTRODUCTION

An underexplored issue in the study of public policy is the degree to which state choices about agency structure (and the nature of the agencies in that structure) impact state environmental policy outputs in the United States (Hoornbeek, 2011; Williamson *et al*., 2021; Morris, 2022). This issue is especially important when the policies being implemented represent national priorities. Such is the case with the rejuvenated emphasis on nonpoint pollution under the Water Quality Act (WQA; P.L. 100-104) of 1987. Under the WQA, states have the option to choose to address nonpoint pollution sources using water quality funds. However, unlike point source pollution, nonpoint pollution has no accompanying regulatory framework. The WQA includes language that allows states to direct resources under the Clean Water State Revolving Fund (CWSRF), a state-run loan fund capitalized by federal grants intended to fund clean water projects in states, to nonpoint projects. While many states avail themselves of this opportunity, a small number of states do not. This paper analyzes the number of annual CWSRF loans for nonpoint projects by each state from 1988, the inception of the CWSRF program, to 2016.

Previous research (see Morris, 1997, 2022) has noted that the administrative structures created by states to administer the CWSRF program differ substantially across the 50 states. These structures may include different combinations of political and administrative actors, and different combinations of state agencies with administrative authority in the program. Morris (1997) noted that some states also involve private sector actors in the decision-making processes in the CWSRF, a circumstance that results in measurable differences in terms of the kinds of communities that receive loan assistance. The CWSRF program allows states to set their own priorities for use of the funds and to create an implementation structure that best fits the needs (and political realities) of the state. This results in a great deal of variation across states in terms of the implementation structure and in the patterns of CWSRF resource distribution. For purposes of this research, the diversity in implementation structures enables us to address our key disciplinary issue: does state agency structure impact state policy outputs in terms of CWSRF program resources?

There are other reasons the CWSRF program is ideally suited to this question. First, the involvement of elected officials at the state level in the administration of the CWSRF program is very limited. This means that most distribution questions are settled by agency personnel in state government, with (at best) minimal input from elected

officials.[1] Thus, the type and mission of the agency may help explain the patterns of distribution from such programs. If the CWSRF program is housed in an infrastructure finance agency, for instance, are the loan patterns likely to be different than they are in a state that houses the program in an environmental agency? Similarly, as Ringquist (1993) asks: do state environmental agencies modeled on the US Environmental Protection Agency – devoted solely to environmental protection issues – produce different policy outputs than state agencies that are multifunctional, including in addition to environmental protection, functions associated with wildlife, and/or natural resources, and/or public health, and/or finance?

Second, states are given much latitude in choosing to fund nonpoint pollution projects (see Houck, 2002; Hoornbeek, 2011). While traditional point source pollution is regulated under the Clean Water Act, Congress made an explicit choice not to regulate nonpoint pollution (Houck, 2002). Lacking a regulatory regime, state efforts to address nonpoint pollution can vary widely. Because there is not a federal mandate for states to fund nonpoint pollution projects, the impact of other state-level policy determinants, which includes state agency structure, we can focus on – sans the uniformity imposed by federal mandates – an explanatory model to assess which state-level determinants play predominant roles in guiding state CWSRF policy outputs in this policy domain. The latitude given to states in this policy arena allows us to focus on state policy and policy implementation factors to determine the degree to which those factors influence policy outputs. Moreover, while this research focuses primarily on the United States, the larger issues of the implementation of policy mandates by subnational units of government may apply to other settings as well.

Finally, this research directs our attention to the applied policy issues associated with the challenges states face when trying to address one of the largest sources of water pollution (see EPA, 2011; Winsten *et al*., 2011; Aron *et al*., 2013), pollution from nonpoint sources. Few federal funding options exist to address nonpoint pollution, and the nature of the CWSRF program means that nonpoint needs must compete with more traditional point source pollution needs. This places even greater pressure on state agencies to allocate scarce resources to meet disparate needs.

The water quality policy arena

The Clean Water Act (CWA; P.L. 92-500) ushered in a new era of protection and regulation for water quality in the United States. The CWA was the vehicle that greatly expanded the federal role in water pollution. In addition to imposing a large-scale federal regulatory program for wastewater modeled on the regulatory framework, the Clean Air Act of 1970, the CWA also greatly expanded funding for water quality projects in the states (Morris, 2022). The CWA requires entities that produce point source pollution (e.g., pollution from the end of a pipe or sewer outfall) to obtain a permit and engage in regular inspection and enforcement (AISWPCA, 2004). States are free to exceed the federal limits for point source pollution, but all states must meet the federal standard. The original 1972 legislation was amended several times over the next 15 years, culminating in passage of the WQA in 1987 (Morris, 2022).

Most of the amendments between 1972 and 1987 involved minor changes to the legislation and did affect the operation of the regulatory requirements or the funding program for point source pollution. Throughout the various amendments to the 1972 legislation, one element remained generally constant: Congress explicitly created a regulatory framework to address point source pollution but chose explicitly *not* to create a regulatory framework for nonpoint water pollution (Houck, 2002; Craig & Roberts, 2015). Nonpoint pollution is water pollution that

[1] Some states, such as Alabama, employ a decision-making body consisting of elected and appointed officials that are charged with approval of funding recommendations by state administrative officials. However, as Morris (2022) reports, these bodies are, at best, 'rubber stamp' bodies; the effective decision authority rests with agency personnel.

ends up in waterways, but emanates from a broad and indistinct area, rather than from a discrete and identifiable source. Examples of nonpoint pollution sources can include pesticides or fertilizer runoff from agricultural land; runoff from suburban neighborhoods, bridges, and highways, pollution settling into water from airborne sources, and natural runoff from wild animal waste, decaying animals and birds, etc. (Houck, 2002).

Because nonpoint water pollution does not emanate from a specific source, control and remediation of nonpoint water pollution poses unique challenges. The lack of a regulatory framework for nonpoint pollution means that states are less invested in nonpoint pollution compared with point source pollution. This has two major implications: first, the lack of a regulatory requirement means that state agencies need not invest scarce resources to meet federal requirements. This not only encompasses direct regulation, but even to activities such as water quality testing. Second, nonpoint programs also tend to receive little attention in most state budgets, so such programs are generally seen as less important or as visible to external constituencies and thus contribute little to an agency's relative political influence within the state. This suggests that nonpoint pollution may be deprioritized by some agencies.

The original CWA included language (Section 303) that requires states to identify waters for which current pollution controls are not sufficient to meet water quality standards, and to develop total maximum daily load (TMDL) requirements for impaired waterways (Gunawardana & McDonald, 2023). The purpose of the TMDL program was to measure the total pollution in a waterway and to take steps to lower the levels of the pollutants found. Such actions might involve changes in permits under the point source regulatory program (known as the National Pollution Discharge Elimination System, or NPDES), but was intended to account for pollution sources in the waterway. The requirements of Section 303 were initially seen as effectively voluntary; lacking dedicated funding and a regulatory requirement; faced with significant needs to meet the point source regulatory requirements set by the NPDES, states (and the EPA) chose to largely ignore Section 303 (see Adler *et al*., 1993; Houck, 2002).

Although the WQA focused attention on point source pollution, Congress did place renewed emphasis on nonpoint pollution in the legislation. The WQA added a new program, known as Section 319, which created a nonpoint management requirement and created a grant program[2] to help states develop nonpoint management plans. The program received scant attention from either EPA or states (Morris, 2022) and little funding from Congress (EPA, 2011), angering many environmental groups (Houck, 2002). Beginning in the early 1990s, environmental groups began to file federal lawsuits against both EPA and states to force EPA to implement Section 303 (Houck, 2002, 5) and the other nonpoint-related provisions of the CWA (Adler *et al*., 1993). The lawsuits were generally successful (Craig & Roberts, 2015), leading states and the EPA to place renewed emphasis on nonpoint water pollution. These lawsuits also compelled Congress to increase funding for Section 319 to allow for demonstration project purposes (EPA, 2011, 2013).

With the passage of the WQA in 1987, Congress opted to move away from a federally funded, federally administered construction grants program (a form of project grant) toward a federally funded, state-administered loan program known as the CWSRF. The goal was to increase state discretion in water quality funding (Morris, 2022), with specific emphasis on the provision of federal funds to help states meet point source regulatory standards

[2] Per the WQA (Section 319 (h)(1)), Section 319 grants may be used to assist states in the implementation of their nonpoint pollution management program. As detailed in Section 319(b), the state management plan should identify best management practices, related programs, schedules for implementation, and other technical assistance and planning functions. The EPA also allowed states to employ Section 319 funds for demonstration projects (EPA, 2013, 7–13) for best management practices. Changes in guidance in the early 2000s (see EPA, 2003a) and a new rule in 2024 (see EPA, 2024), coupled with increased federal funding expanded the project-based uses of these funds, but the rules still require states to use Section 319 funds for the planning uses listed in the law.

under the CWA. These needs include construction of new wastewater treatment plants, sewer collection systems, combined sewer overflow remediation, and other projects centered around point source water pollution treatment. Congress specified the allowable uses for these funds and, for the first time, included nonpoint water pollution projects in the list of allowable uses. While some states embraced the expanded uses for wastewater infrastructure funding, other states refused to fund any projects other than those for point source pollution needs (e.g., wastewater treatment plants, new sewer lines, etc.). In a sense, the CWSRF program was highly successful; it empowered states to make their own funding decisions and to set their funding priorities (Morris, 2022). Some states have funded nonpoint pollution projects in their state, while others have never used CWSRF funds for nonpoint projects. However, the CWSRF program is the largest source of federal funds available for nonpoint projects. The EPA noted in its 2013 guidance for Section 319 grants that states had not utilized their CWSRF funds for nonpoint purposes, and encouraged states to do so (EPA, 2013, 12–13). Moreover, the CWSRF program has been funded at about $1 billion per fiscal year, compared with about a tenth of that amount for the total Section 319 program (EPA, 2011). Why have some states embraced the use of CWSRF funds for nonpoint pollution while others have committed fewer (or no) CWSRF resources to nonpoint projects?

A THEORY OF STATE CHOICE

Few existing studies examine state choices in water quality funding, and even fewer studies employ a 50-state, multi-year design. There are several studies that offer qualitative case studies of state choices (e.g., Morgan & Matlock, 2008) or the effectiveness of collaborative efforts to address nonpoint pollution (Leach *et al.*, 2002; Nikolic & Koontz, 2008), and studies that examine the CWA/nonpoint pollution/ TMDL requirements through a legal/ constitutional lens (Birkeland, 2001; Garovoy, 2003; Adler, 2013; Craig & Roberts, 2015; Andreen, 2016). Gunawardana & McDonald (2023) examined socioeconomic indicators to predict state progress in the TMDL program but found that the EPA region was a significant factor in predicting state TMDL progress, particularly in terms of the percentage of waterways assessed. There are few studies in the literature that examine state commitment to nonpoint funding, or that examine the tradeoffs between nonpoint and point source pollution funding; likewise, we did not identify any study that examines the effect of implementation structure and agency type on environmental program outputs.

One of the most comprehensive studies of state choice in the CWSRF program is Morris (2022). The work employs a range of dependent variables that seek to measure state decisions to fund significant environmental need, small communities, financially at-risk communities, and nonpoint projects. The independent variables include financial, structural, political, and water quality needs variables, and controls for a range of socioeconomic variables (Morris, 2022). The study concludes that states have done a reasonably good job of meeting congressional intent in the WQA to meet significant environmental (point source) need[3] but have been less successful at meeting nonpoint pollution needs.

This current work differs from Morris (2022) in some important ways. First, we employ a different measure of agency type. While Morris (2022) focused on the nature of the implementation agency for the CWSRF, this paper substitutes a measure that captures the nature of the environmental agency, rather than limiting agency differences in the CWSRF program. Second, we employ several nonpoint-specific variables in our model, including a measure of the percentage of agricultural land in a state (a significant source of nonpoint pollution), and a variable representing state receipt of Section 319 funding. Third, we are also interested in regional variation;

[3] The WQA (and EPA, 1988 guidance) describes 'significant environmental need' as the resources needed to comply with the regulatory requirements of the CWA under the NPDES (i.e., point source pollution).

specifically, whether southern states are more or less likely to direct CWSRF resources to nonpoint needs. Finally, we employ a negative-binominal regression technique to analyze the number of CWSRF nonpoint loans funded versus Morris's choice to analyze the percentage of nonpoint CWSRF loans funded. This issue will be discussed in detail in the methods section.

Mullin & Daley (2018) examine water quality funding but focus more on federal-level data and total state environmental spending. Clark & Whitford (2011), Morris (1997), and Williamson *et al.* (2021) all examine measures of dollars spent by states. One of the few 50-state comparative studies that examines state nonpoint pollution policy is Hoornbeek (2011; see also Hoornbeek, 2005). While Hoornbeek addresses nonpoint pollution, his focus is on the development of a measure of state commitment to nonpoint pollution, rather than on an explanation of state policy behavior. Given the dearth of state comparative policy studies that address nonpoint pollution, we offer a model of state policy choice to explain state nonpoint funding decisions in the CWSRF program.

Our theoretical framework for understanding the funding of nonpoint pollution projects is derived partially from the state policy determinants literature (Dye, 1966, 1984), which found that partisan politics and party competition played less of a role in state policy choices compared with each state's economic capacity to address issues. While Dye's model has fallen out of favor (Erikson *et al.*, 1993), a modified version of Thomas Dye's approach fits in this policy domain because states exercise total control over funding nonpoint pollution projects through the CWSRF program and as a technical issue, we expect that partisan politics and ideology will play almost no role in determining the funding of nonpoint projects compared with a state's economic capacity to do so. We differ from Dye's state policy determinants model in that our model includes other independent variables specific to this policy domain (discussed below) and we include as a key explanatory variable the type of implementation agency.

The dependent variable

Our dependent variable consists of a count of the number of CWSRF loans allocated in each state annually for nonpoint needs as reported by states and compiled by the EPA (2020).[4] By employing a measure of the number of loans, we can gauge the relative weight of the nonpoint pollution program within CWSRF loan framework for each state. We avoid using the percentage of loans allocated to nonpoint projects within each state as Morris (2022) does, because from year to year, the number of loans (the denominator) varies due to the relative costs of the funded projects and the amount of money available in the revolving loan fund. In addition, the modal category for our dependent variable is 0, which produces an over-dispersed variable that a negative binomial method is best able to address.

Independent and control variables

We divide our independent variables into three categories. The first category describes state choices in terms of program structure and operation. The second category contains variables that describe the programmatic tradeoffs between traditional point source and nonpoint source pollution. The third set of variables controls for each state's evolving political, physical, and population characteristics, partially derived from the state policy determinants literature.

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[4] In addition, the relative sizes of CWSRF programs vary significantly from state to state. Each state receives an annual grant based on a formula that appears to be based on a combination of water quality needs and population (see Morris *et al.*, 2024) that is matched with a 20% state share. States are free to add additional funds through leveraging or additional state contributions; while some states leverage (see Travis *et al.*, 2004), few states contribute additional state funds (see Morris, 2022). The corpus of the CWSRF fund is thus a function of the size of the state and its needs, so comparing dollars will reflect the size of the overall CWSRF program and not commitment to nonpoint pollution projects.

Institutional structure and operation

We capture a state's implementation structure with a combination of three variables. First, one of the most fundamental decisions a state must make regarding a nonpoint pollution program concerns the nature of the state agency charged with implementation of the state program, which represents a choice made by states. The ways in which a program fits, or fails to fit, into the missions of the implementing agency speaks to the kinds of decisions made by the agency in the administration of the program (Hopper, 2017, 2020). As noted by Morris (2022), Williamson *et al.* (2021), and Ringquist (1993), the structure and mission of the implementing agency can determine the outputs of programs for which the agency is responsible. Morris (2022) reports that environmental agencies direct the bulk of their clean water resources to point source environmental need, few states fund projects for water reclamation, nonpoint projects, green infrastructure, or other allowable uses. This suggests an institutional bias toward more traditional water pollution programs – something state environmental agencies have been doing for decades. Given a choice of directing resources toward point source projects and nonpoint source projects, state environmental agencies tend to favor the former.

Even though there is this bias among most state environmental agencies toward point source projects, we expect that the nature of the implementing agency will be a determining factor in a state's propensity to fund nonpoint projects. We classify implementing state environmental agencies by the number of other major departmental functions that are included under the same agency umbrella. We expect that the more that the state's implementing agency is structured like a mini-EPA (see Ringquist, 1993), the more likely that traditional point source environmental/water quality policies will dominate a state's implementing agency, the less likely that state will fund nonpoint pollution projects.

Why? The answer is complex. On the one hand, when states combine environmental departments with other functional areas, it is usually because they are combining smaller departments under a larger agency umbrella (see Hopper, 2020). As such, these environmental departments are likely to be understaffed and are more likely to lack the personnel/organizational capacity to invest time and positions toward understanding the need to fund nonpoint pollution projects. Indeed, the mere fact that environmental functions are combined with multiple other policy arenas is a statement of the importance, or lack thereof, of environmental policy issues. Hopper (2017, 2020) also argues that the regulatory function of 'mini-EPA' agencies as opposed to agencies with a public health or conservation mission can result in different policy outcomes because of different constituencies, processes, missions, and cultures. There is an inherent political competition for resources that takes place within the context of any state agency. The more functional areas that are combined within a state agency, the more competition there is among policy initiatives for support.

For example, Hopper (2020) notes that public health agencies, the home of many water quality programs until the 1970s, may see environmental health as secondary to other health policy programs. A state agency with responsibility for Medicare, Medicaid, and the Affordable Care Act, for instance, is likely to prioritize these large health programs over a nonpoint pollution program. The budget commanded by Medicare and Medicaid is measured in tens of billions of dollars, whereas the average state nonpoint program may have a budget of a few million dollars per year. Likewise, if water pollution is paired in a super-agency with natural resources and conservation (a very common model), Hopper (2020) notes that the functions are generally quite different. Conservation programs generally involve the maintenance of state lands, wildlife populations, etc., while water (and air) pollution programs are regulatory, and focused on very different outcomes. While both might involve some form of regulation, the purpose of the regulation is quite different (Hopper, 2020, 18). So, one could argue that the lack of focus in agencies not focused on environmental issues might be less likely to focus on nonpoint pollution programs.

On the other hand, the EPA agency model is grounded in a culture of environmental regulation, or 'dark green' (Ernst, 2010) approaches to environmental policy. The Clean Air Act of 1970, one of the EPAs first policy implementation responsibilities, introduced a model of regulation that was duplicated in later environmental legislation (see Milazzo, 2006) in much of the national environmental legislation enacted in the 1970s and 1980s. As a result, one of the EPA's major functions is environmental regulation. States that followed the 'mini-EPA' agency model also placed the environmental regulatory function in their state agency (Ringquist, 1993), which in turn elevated the importance of the regulatory mission to environmental policy in these agencies – in a sense, this is one of the defining characteristics of a 'mini-EPA' agency. As noted earlier in this paper, there is a national framework to regulate point source water pollution, but not nonpoint pollution. We suggest, given the high-profile nature of the regulatory mission, and the accompanying pressures to meet regulatory requirements, that 'mini-EPA' agencies are less likely to direct resources to point source projects than nonpoint projects. Super-agencies incorporate many missions that go well beyond regulation. In super-agencies, then, the regulatory mission for water quality is less likely to be a focal point of the agency's activity. Super-agencies must balance a number of competing missions and functions, and may be more adept at navigating different constituencies and priorities.

Following Ringquist (1993) and supplemented by data reported by Hopper (2020) and Morris (2022), we develop a measure that describes the nature of the state implementing agency for the CWSRF program regarding the prevalence of environmental issues are within the state agency. The categories are mini-EPA, health agency, super-agency, and other. The Supplementary Appendix details which agency type is associated with each state.

An agency described as a 'mini-EPA' denotes an environmental agency modeled after the USEPA; such an agency is limited to environmental policy and features a regulatory function. A health agency combines the environmental and public health functions in a single entity. Indeed, until the 1960s, most states located their water quality programs in state health departments, a practice that followed the federal practice of treating water quality as a public health issue (Morris, 2022). After the creation of the USEPA, some states reorganized and moved water quality to a 'mini-EPA' environmental agency. A 'super-agency' is a state agency that includes the state's environmental functions, but also includes natural resources, conservation, wildlife, or related functions. The final category covers the four states that combine their environmental functions in state agencies that are atypical of other states. The atypical pairing may signify that a state may not prioritize environmental policy, thus it can be paired with a function that is dissimilar. In both instances, such an agency, where environmental issues must compete for attention and funding, may de-emphasize environmental concerns in favor of other agency priorities (Ringquist, 1993).

H_1: *States with a mini-EPA agency will direct a smaller number of CWSRF loans to nonpoint uses. States where environment and health functions are combined in one agency will direct a larger number of CWSRF loans to nonpoint projects compared to mini-EPA agencies. Finally, states where environmental functions are in super-agencies or combined with other state agencies in an atypical manner will fund the lowest number of CWSRF loans to nonpoint projects.*

Programmatic tradeoffs

The CWSRF program represents a finite source from which states can fund water quality needs. As part of the WQA, the CWSRF has always been seen, first and foremost, by both Congress and states, as a program to help states meet the regulatory requirements of the CWA (EPA, 1984, 1988). Put another way, the focus of the CWSRF is to meet significant environmental need to control point source pollution. As noted previously,

significant environmental need represents the funds needed to bring wastewater facilities into compliance with their NPDES permit. Because funds are limited, allocating funds for nonpoint projects means less money available for traditional point source issues (see Mullin & Daley, 2018; Morris, 2022). While this is not a zero-sum game between loans for point source versus nonpoint source – largely because nonpoint source projects tend to cost much less than point source projects (Morris, 2022) – each state's willingness to fund nonpoint projects is tied to their need to fund projects for significant point source environmental need.

H_2: *States that direct a larger number of their CWSRF loans for significant environmental (point source) need will be less likely to direct CWSRF loans to nonpoint uses*.

States differ in terms of their infrastructure needs to meet water quality needs. A feature of the WQA, states are required to provide quadrennial estimates of their current and future point source infrastructure needs to the EPA. These reports estimate the amount of money necessary for the state to remain in compliance with the regulatory requirements of the CWA (EPA, 1989, 1993, 1997, 2003b, 2008, 2010, 2012a, 2016). For states, there is a tradeoff between point source and nonpoint source funding. If a state has significant point source needs, the looming threat of regulatory enforcement makes nonpoint projects less attractive as a policy choice. On the other hand, a state with relatively modest point source needs may be more willing to direct CWSRF resources to nonpoint pollution needs.

H_3: *States with higher point-source water quality needs are less likely to direct a larger number of CWSRF loans to nonpoint uses*.

Section 319 of the CWA provides for grants from EPA to states to assist with technical assistance, projects, training, and other related uses for approved nonpoint source management programs (EPA, 2023, 2024). States submit proposed plans to EPA for approval. The purpose of these funds is to assist states in the development and operation of an effective nonpoint pollution program. Funds are awarded to eligible states annually, and states are expected to update and revise their plans at least every 5 years (EPA, 2012b). This study employs the number of Section 319 projects in a state each year as a measure of a state's commitment to nonpoint protection. Because the grants are tied to the amount of nonpoint program activity in a state, states with more Section 319 projects should have a more robust nonpoint program and be more likely to direct CWSRF resources to nonpoint projects.

H_4: *States that are awarded more* Section 319 *projects are more likely to direct a larger number of CWSRF loans to nonpoint uses*.

Control variables: political, physical, regional, and economic development

By virtue of their geography, coastal states tend to have more waterways that pass through the state. In addition, coastal states, by definition, have coastal waters that fall under their jurisdiction, and are therefore subject to nonpoint pollution runoff (Jansen, 2003). Following Hoornbeek (2011), we include a dummy variable that indicates whether a state is a coastal state. Given the heightened importance of nonpoint pollution in coastal states, we expect coastal states to have more robust nonpoint programs.

H_5: *Coastal states are more likely to direct a larger number of CWSRF loans to nonpoint projects than noncoastal states*.

One of the largest single categories of nonpoint pollution is runoff from farming operations (Adler, 2013). This runoff can include excess fertilizers (nitrogen and phosphorous), as well as a range of pesticides and other chemical pollutants (EPA, 2022a). Runoff can also include bacteriological pollutants from farms with large animal populations. Generally, a very conservative group, farmers and ranchers (and agricultural interest groups) tend to resist regulatory (or voluntary) programs that might alter crop production (e.g., less fertilizer or pesticide; Lubell & Fulton, 2008) or livestock feeding routines. Our surrogate representing the relative importance of agricultural interests in a state is the percentage of land devoted to agricultural production. States with a higher percentage of land in agricultural production should be less likely to support funding of nonpoint pollution projects.

H_6: *States with a higher percentage of agricultural lands will direct a smaller number of CWSRF loans to nonpoint projects than states with a higher percentage of agricultural lands.*

The remainder of the variables in the model comes from the state policy determinants literature. Following Dye (1966), we assess a state's economic development using state median income. The higher the median income of a state, the greater the economic capacity to fund nonpoint pollution projects. Also included in the analysis are two political variables. The first is a measure of state policy liberalism from Caughey & Warshaw (2016); this variable is coded so that higher values indicate a higher level of conservatism. If state ideology has an effect, we expect that more conservative states will fund a lower number of nonpoint projects (see Morris, 2022). The second political variable is a dummy variable representing if the state's governor is a Republican. The effects of partisanship on environmental outputs have been examined at length (see, for example, Kamieniecki, 1995; Konisky *et al.*, 2008; Turner & Isenberg, 2018). Fowler & Kettler (2021) find that party control of Congress matters more for state-level pollution releases than partisan control of either state governorships or state legislatures, although Morris (2022) finds state party control by Republicans a significant factor in the distribution of CWSRF loans for water quality projects, with states controlled by Democratic Party generally more willing to direct resources to small and financially at-risk communities. If GOP of the governor's office has an effect, we expect that states with a GOP governor will fund a lower number of nonpoint projects (see Williamson, Morris, & Fisk, 2021). However, consistent with Dye, we expect state ideology and GOP control of the governor's office to be unrelated to the number of funded nonpoint pollution projects.

H_7: *States with higher median incomes will direct a higher number of CWSRF loans to nonpoint projects than states with lower median incomes.*

H_8: *States with higher policy conservatism scores will not have an effect on the number of funded CWSRF nonpoint projects.*

H_9: *GOP control of the governor's office will not predict the number of CWSRF loans to nonpoint projects.*

Finally, we include a control for the 11 states of the old Confederacy, 'the South'. There is much research suggesting that the Southerners tend to be one of the more conservative regions in the U.S. (Bullock & Rozell, 2021) and thus generally less supportive of government intervention into environmental issues (Emison & Morris, 2010). Following this conservative political culture, southern states implement a range of policy issues, including the WQA and other environmental policies in a more conservative manner (Emison & Morris, 2010; Morris *et al.*, 2022). Given this research, we include a 'southern state' dummy variable in this analysis.

H_{10}: *Southern states will fund a fewer number of CWSRF nonpoint projects than non-southern states.*

DATA AND METHODS

Data for this analysis are drawn from several sources. Our dependent variable is coded from EPA's National Information Management System (NIMS), a database that captures more than 200 variables related to the CWSRF program (EPA, 2020). These data were first published in 1988 and are updated annually. Our analysis spans the period from 1988 to 2016. Data for water quality needs are also drawn from EPA's Clean Watersheds Needs Surveys, from 1988 to 2016, and data for the number of Section 319 projects for each state each year are from EPA (2022b). The measure of agency type is calculated using the definitions provided by Ringquist (1993) and updated with data reported by Hopper (2020) and Morris (2022). Our measure of the percent of agricultural land is calculated from the USDA's National Agricultural Statistical Service (2000–2016), which publishes annual reports listing the total acres of agricultural land by state. The total acreage is converted to square miles, and then divided by state land area in square miles. Our measure of government ideology is drawn from Caughey & Warshaw (2016), and data for Republican control of the governor's office are drawn from the National Council of State Legislatures (NCSL, 2020) where GOP control is coded 1 and all others 0. The South is a dummy variable coded 1 for the 11 Confederate states and 0 for non-South states. All data were analyzed using Stata version 18. Table 1 summarizes the mean/frequency and standard deviation/percent of cases for the dependent variable and each of the independent variables, and the Supplementary Appendix contains specific information on data sources and definitions.

Table 1 | Summary of means and standard deviations.

Variable	Obs	Mean or Freq	Std dev or %
Dependent variable			
Number loans nonpoint	1,450	11.50	45.09
Policy environment variables			
Number loans for sig. env. need	1,450	9.14	14.41
Water quality needs ($)	1,450	1,651.70	2,763.35
No. Section 319 projects (lagged)	1,400	16.94	15.45
State institutional dummy variables			
Super-agency	1,450	486	33.52
Mini-EPA	1,450	137	9.45
EPA/Health	1,450	740	51.03
Other/EPA	1,450	87	6.00
Environmental conditions			
Coastal state (dummy variable)	1,450	783	54.00
% Agricultural land	1,450	41.68	24.95
Political and economic conditions			
State policy ideology	1,450	0.00	1.13
GOP governor (dummy variable)	1,450	763	52.62
Median income (2,005$)	1,450	57,875.81	9,213.35
South dummy variable	1,450	319	22.00

As noted earlier, our dependent variable is a counts variable, the number of nonpoint loans awarded annually by states from 1988 to 2016. The modal category is zero, no loans. Given the large number of zeros and the over-dispersed nature of this variable, we employ a negative binomial cross-sectional time-series design:

$$\Pr(Y_{it} = y_{it}|\delta_i) = \frac{\Gamma(\lambda_{it} + y_{it})}{\Gamma(\lambda_{it})\Gamma(y_{it} + 1)} \left(\frac{1}{1 + \delta_i}\right)^{\lambda_{it}} \left(\frac{\delta_i}{1 + \delta_i}\right)^{y_{it}}$$

where y_{it} is the count for the t-th observation in the i-th group (StataCorp, 2023, 389). We did not estimate our parameters using a fixed effects model because of the large number of sluggish and dummy variables included as independent variables. Fixed effects models tend to preclude estimation of these types of variables. Instead, we estimated coefficients and their associated confidence intervals using a random effects model with jackknifed standard errors (50 replications) clustered by state.[5]

RESULTS AND DISCUSSION

Table 2 presents the results of the negative binomial panel model. We ran tests for multicollinearity and the results suggested that it is inconsequential (Variance Inflation Factors < 5, Conditional Index < 30). The message of Table 2 is that institutional variables matter for predicting the number of funded nonpoint projects among states. Compared with mini-EPA agencies, all three other agency types are more likely to fund nonpoint projects. Combined health/environment agencies and those agencies that are classified as super-agencies are more than four times as likely compared with mini-EPAs to fund nonpoint projects. The 'other' agency types are 7.6 times more likely than mini-EPAs to fund nonpoint projects. These findings are consistent with the spirit of our theoretical framework, but as noted above, not perfectly. Instead, we find that the pairing environment with any other agency other than being by itself in a mini-EPA type agency creates a more fertile policy environment for funding nonpoint projects. We note that Hopper's (2020) argument regarding the regulatory functions of different structures of environmental agencies may come into play here, in that mini-EPA state agencies may adopt a more regulatory focus compared with agencies combined with other functions, due primarily to differences in agency constituency, mission, and culture. Because nonpoint pollution does not fall under a regulatory regime as does traditional point source water pollution, it appears that mini-EPAs direct agency resources to the types of projects that fall into these traditional regulatory regimes.

The number of loans for significant environmental (point source) needs does not have a statistically significant effect on the number of nonpoint projects. Similarly, states' estimates of the dollars that they will need in the longer term to meet the regulatory requirements of the CWA is also insignificant (Hypothesis 3). We expected both of these variables to have a negative effect because both are indicative of each state's point source future needs, which as noted before, often require expensive solutions, and perhaps soak up the available resources for making loans for nonpoint source projects. This was not the case; we suspect that a combination of the long lead time and scale of point source projects compared with nonpoint projects may limit our ability to compare the two types of projects as a direct tradeoff; additional research is warranted here. The lagged[6] number of

[5] We considered a zero-inflated negative binomial model, but zero-inflated methods have not been adapted to cross-sectional time-serial data and we have no separate variable to include in the model that explains the large number of zeros independent of the counts 1 through n.

[6] This variable is lagged by 1 year to account for the lead time necessary between planning and implementation of nonpoint projects using CWSRF funds. As mentioned earlier, although Section 319 funds can be used for projects, states also use these grants for planning. We thus allow for a time gap between planning and implementation.

Table 2 | Negative binomial XTCS model with bootstrap standard errors, dependent variable: number nonpoint CWSRF loans.

	Coefficient	Incidence rate	Jackknifed SE	z	P>|z|	95% Confidence interval	
Policy environment variables							
Number loans sign envir. needs	0.015	1.015	0.018	0.800	0.429	−0.022	0.051
$ Water quality needs	0.000	1.000	0.000	0.990	0.328	0.000	0.000
No. Section 319 projects (lagged)	**0.012**	**1.012**	0.003	4.310	0.000	0.006	0.018
State agency dummy variables							
Agency type (Mini-EPA is the comparison group)							
Super-agency	**1.444**	**4.236**	0.580	2.490	0.016	0.278	2.609
Health/EPA	**1.568**	**4.797**	0.474	3.310	0.002	0.616	2.520
Other/EPA	**2.026**	**7.581**	0.733	2.760	0.008	0.552	3.500
Environmental cond.							
Coastal state	−0.415	0.660	0.571	−0.730	0.471	−1.563	0.733
% Agricultural land	−0.014	0.986	0.011	−1.210	0.232	−0.037	0.009
Political and economic conditions							
State policy ideology	0.410	1.506	0.257	1.590	0.117	−0.107	0.926
GOP governor (dummy variable)	0.104	1.110	0.172	0.610	0.548	−0.242	0.450
Median income (2010$)	**0.0001**	**1.0001**	0.000	2.790	0.007	0.000	0.000
South dummy variable	−0.861	0.423	0.589	−1.460	0.151	−2.045	0.324
Constant	**− 5.614**	**0.004**	1.265	−4.440	0.000	−8.156	−3.073
/ln_r	−0.599		0.167			−0.935	−0.264
/ln_s	−0.209		0.235			−0.682	0.264
r	0.549		0.092			0.393	0.768
s	0.811		0.191			0.506	1.302

LR test vs. pooled: chibar2(01) = 802.55. Prob >= chibar2 = 0.000.
Values in bold show significant coefficients.

Section 319 projects has a positive and significant coefficient (Hypothesis 4) as expected. States that seek Section 319 grants are signaling that they are interested in funding future nonpoint projects.

Neither coastal states nor the percent of agricultural land have significant effects. Of these two variables, we expected the politics of states with a higher percentage of land devoted to agricultural production to have an incentive to stifle nonpoint project funding, many of which stem from modern agricultural production processes that entail using chemical fertilizers and herbicides on row crops. Perhaps because most nonpoint projects represent rather small investments, these projects are not large enough to attract the attention of agricultural interests within states.

We see support for our modified policy determinants model. As expected, political variables do not play a large role in determining the number of funded nonpoint projects. GOP partisan control of governor mansions and ideology both have insignificant effects on the number funded of nonpoint projects (Hypotheses 8 and 9). Median income, on the other hand, has the expected positive effect (Hypothesis 7) on the number of funded nonpoint projects. Finally, while the coefficient of the South dummy variable is negative as expected (Hypothesis 10), its significance level is well above 0.05.

Bundled together, these findings underscore that, in the latter part of the 20th century and first part of the 21st century, state institutional settings matter for allocating for nonpoint source loans. States where the water quality agencies are coupled or bundled with other agencies are much more supportive of nonpoint source loan projects. This should not be surprising given that states with mini-EPA agencies are the most devoted toward regulatory issues and thus want to fund projects that are directly associated with that regulatory mission. States with more economic resources, as reflected in higher median incomes, are more likely to fund nonpoint pollution projects, while neither GOP control of the governorship or ideology plays a significant role. This suggests that the Dye's policy determinants model may still have relevance in this state policy arena. Finally, environmental characteristics associated with coastal states and states with a higher percentage of farmland had no impact on the number of funded nonpoint projects.

CONCLUSIONS

State support to address nonpoint water pollution represents a complex policy environment. While few dispute the importance of nonpoint pollution as an environmental concern, the lack of a federal regulatory mandate, coupled with limited resources, means that nonpoint pollution concerns must compete for policy attention in a policy space dominated by point source programs. This research begins to bring into focus how states navigate this space, and the effects of the type of institutional structure that states create for program implementation.

Compared with traditional point source water pollution, nonpoint water pollution receives very little in terms of dedicated federal financial support. The WQA authorizes funds for nonpoint pollution under Section 319, but these are both limited in size and are meant to meet several purposes in addition to project construction (EPA, 2011, 2023, 2024) – the CWSRF remains a significantly larger source of federal funds to address nonpoint water pollution. While the WQA also includes nonpoint projects in the allowable uses for the CWSRF program (Morris, 2022), the WQA (and its legislative predecessors dating back to 1948) clearly place congressional interest in infrastructure-intensive uses to address point source pollution (Milazzo, 2006). The fact that nonpoint pollution is not subject to a regulatory framework provides states scant incentive to direct CWSRF resources to nonpoint projects. Nonpoint pollution is generally not a high priority for state funds; very few states have sizeable state-funded nonpoint pollution programs. Even court-ordered action to create TMDL agreements seems to have little impact on the allocation of state resources to address nonpoint pollution.

Our research suggests that an important factor in determining the number of nonpoint projects is the nature of the agency charged with environmental protection. Agency mission, priorities, and complexity may impact the degree to which a type of agency is willing (or able) to address nonpoint pollution and its propensity to fund nonpoint pollution projects. While this research provides a first look at the effect of implementation structure, future research may include other structural/administrative variables, including the size of the lead agency's budget, number of state personnel, or other measures of the relative size and scope of the state's environmental program.

Future research efforts should also seek to better understand the relationship between a state's commitment to nonpoint pollution and problem severity. Given the paucity of accurate, reliable, and recurring data on impaired waterways (Houck, 2002; Hoornbeek, 2011; Morris, 2022), further investigation is needed to identify and employ a measure of nonpoint need. Our suspicion is that policy need will not be a strong predictor of state distributive choices in this program, but it should shed additional light on state behavior. Likewise, the addition of state budget data on state nonpoint funding programs, lawsuits regarding TMDL agreements, or the relative strength of the agricultural lobby in a state may provide a deeper understanding of state choices. Finally, while we show evidence that agency type makes a difference for nonpoint pollution programs, it remains the subject of future research to determine whether the nature of the implementing agency generates variation in program outputs across a range of other policy arenas.

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DATA AVAILABILITY STATEMENT

All relevant data are available from https://cla.auburn.edu/directory/joseph-aistrup/.

CONFLICT OF INTEREST

The authors declare there is no conflict.

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