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## The role of water quality for local environmental policy implementation

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The objective of this study is to examine the role of surface water quality for the decisions by Swedish municipalities to adopt environmental targets and action plans, as well as allocating these decisions to a responsible authority. To this end, we assess how environmental, socioeconomic, and political factors, as well as the availability of environmental expertise, affect these municipal decisions. Questionnaire data from the Swedish Association of Local Authorities and Regions, in combination with environmental monitoring data and official statistics, are used for the econometric analysis. Results show that: (i) municipalities with bad water quality, greater coastal length, and higher income are more inclined to adopt local policies; (ii) collaboration with interest groups increases the likelihood of adopting local policies; and (iii) municipalities with high Center Party representation tend to set responsibility for environmental policy with the municipal council board.

**KEYWORDS:** environmental expertise; local environmental policy; logistic regression; stakeholder participation; Water Framework Directive

### 1. Introduction

The European Union Water Framework Directive (WFD) of 2000 (2000/60/EC) requires that surface water quality is managed at the river basin level, implying that policy decisions are taken at a regional or local level. The WFD further requires the development of river basin management plans that should outline the set of measures required to achieve good ecological status for all water bodies. In the context of Sweden, five regional Water Authorities were announced. Despite these authorities being responsible for the development of environmental targets and action plans, they have neither the authority over policy instruments nor the funds to subsidize measures (Hammer *et al.* 2011; Andersson, Petersson, and Jarsjö 2012). For the WFD to have an effect, it is therefore necessary for the local governments, that is, the municipalities, to take action. This was foreseen at an early stage where the national government claimed that the WFD should imply a considerably stronger role for water in municipal physical planning and pointed out that the municipalities shall comply with agreed environmental goals introduced by higher level governments (Government 2002). However, implementation at the municipality level is, in principle, voluntary due to the lack of sanctions and other

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consequences in the case of non-compliance (Gooch and Baggett 2013; Voulvoulis, Arpon, and Giakoumis 2017). A local government's decision on whether to adopt an environmental target or policy can therefore be expected to be determined by the perceived benefits and costs, as well as institutional and political conditions that facilitate or hinder implementation at the local level (Martin-Ortega *et al.* 2014).

The purpose of this paper is to investigate the role of surface water quality for the implementation of environmental objectives in Swedish municipalities. We conjecture that water quality plays a particularly important role in this context because of requirements posed by the WFD and the observation that water quality is often seen as a main indicator of the effectiveness of local environmental policy and planning (Burstrom *et al.* 1997; Hammer *et al.* 2011). We hypothesize that the adoption of local environmental goals and action plans is determined by the environmental benefits that accrue from their implementation and access to environmental expertise for their development. To analyze these issues, we apply a revealed preferences approach where we investigate how implementation outcomes depend on the potential benefits, access to expertise, stakeholder participation and political representation in the municipal council. Here, we take into account that access to expertise could be enhanced during the process by appointing a responsible body with high professional competence. Data on implementation are obtained from a questionnaire<sup>1</sup> carried out by the Swedish Association of Local Authorities and Regions (SKL) in 2011 (SKL 2012), which is complemented by data from official statistics and publicly available databases.

The previous literature relevant to our study is that which examines policymakers' actual decisions on environmental policy and infers the criteria that determined these choices (McFadden 1976). Such studies of revealed preferences carry out a positive analysis of past governmental choices. Thus, the method does not presuppose that governments act in a socially optimal manner, but rather helps to understand the relative importance of societal costs and benefits, institutional factors, and stakeholder influence for policy decisions taken. Several studies have applied the revealed preferences method to policymakers' decisions on projects and actions to improve water quality. For example, the study by Magat, Krupnick, and Harrington (2013) suggests that the EPA places little weight on economic efficiency when setting standards for water pollutants; instead decisions are mainly determined by the strength of the trade association representing the affected industry, and the profitability of the industry. Helland (1998) analyzes the revealed preferences of state-level EPAs showing that budgetary resources and the viability of the local economy affect enforcement of the Clean Water Act. Berrens *et al.* (1999), in the context of New Mexico, show that it is not just environmental risk that affects decisions for underground storage tanks; local economic and social factors are also important, and the threat of leakage. In the context of the North American Free Trade Agreement (NAFTA), Fernandez (2004) analyzes how environmental project attributes influence a NAFTA institution's approval for their implementation. Elofsson and von Brömssen (2017) evaluate the determinants of the implementation of nutrient abatement measures in the Baltic Sea countries, accounting for the type of pollutants addressed, policy instrument choice as well as financial and institutional capacity. For the present study, the revealed preferences approach is relevant because of the complex nature of municipalities' decisions on environmental policy implementation, in combination with our aim to identify the role that water quality has played in decisions taken.

The remainder of the paper is structured as follows. In Section 2, we provide a more detailed background and present our hypotheses. In Section 3, we outline the

econometric model, and provide a description of the data. Section 4 presents the results, and Section 5 provides a discussion and concluding remarks.

## 2. Background and hypotheses

At the national level, the Swedish parliament has adopted 16 environmental quality objectives, which should be met by the year 2020. Despite progress in many areas, these targets are not likely to be met on the set date (EPA 2018). For the objective ‘Zero Eutrophication’, which is relevant to surface water quality, the EPA observes that the objective cannot be achieved with the present set of national policy instruments and measures. The situation is argued to be due to inadequate water and sewerage pricing policies, high costs for meeting the ambitious targets, difficulties in distributing these costs among sectors and stakeholders, complexity of government structures, and potential political backlash (Keenleyside *et al.* 2009; Kirschke *et al.* 2017). To enhance the probability of success, the Swedish EPA recommends that local authorities take ownership of environmental targets and policy design, and encourage environmental interest groups, business, and the public to participate in the decision process (Weichelt 2009; EPA 2012a, 2012b).

Sweden has a long history of constitutionally guaranteed local autonomy, with greater authority than most other European countries (Hysing 2009). Local municipalities decide upon spatial planning, sewage, and wastewater management; however, they are obliged to follow national environmental mandates and laws (Jörby 2002). Increasingly, local authorities have adapted national and regional environmental targets, as well as action plans, for their own local situations. At best, such decentralization of environmental policymaking can imply enhanced economic efficiency and democratic accountability, for example, if local policymakers have better information on local preferences and greater discretion to efficiently tailor implementation to local conditions (Uphoff 1992).

In this paper, we put forward three hypotheses regarding the development of environmental policy at the municipality level: (i) the level of implementation of environmental policy is determined by the associated local environmental and social benefits and costs; (ii) the need for, and availability of, environmental expertise affects the level of implementation and the allocation of the responsibility for implementation; and (iii) stakeholder participation and political representation can increase or decrease the level of implementation, depending on the type of interests represented. This section first discusses measurement of policy implementation, then outlines the hypotheses in further detail.

### 2.1. Measuring implementation of environmental policy

Implementation of environmental policy could be measured through the outputs achieved in terms of binding decisions or plans and their level of stringency, the operationalization of these outputs in terms of actions and measures undertaken with the aim of meeting the agreed objectives, and the environmental outcomes in terms of the resulting change in the state of the environment (Koontz and Thomas 2006; Newig *et al.* 2018). In this study, we define implementation in terms of the existence of agreed local environmental targets and action plans; that is, our measure falls within the first of the above categories. Moreover, the process of developing goals and action

plans could be more or less interlinked, and we therefore consider the possibility that the two outcomes are separately or jointly determined. Thus, our analysis provides knowledge about the ambitions of local governments in the first step of the environmental policy implementation process, the establishment of goals and plans, while we do not account for the later stages where policymakers decide on the allocation of resources, ensure that physical action is undertaken, and follow up on the resulting environmental effects.

## **2.2. Local benefits and costs of environmental policy**

Policymakers who strive to maximize citizen welfare should consider the costs and benefits of their decisions. If damage from pollution is increasing at an increasing rate, which is typically assumed in economics (Shortle, Abler, and Horan 1998), the presence of higher pollutant concentrations implies greater benefits from the implementation of environmental policy, *ceteris paribus*. Also, low water quality implies that greater efforts are necessary to meet WFD targets. A large water area and a high length of coastline can be expected to imply that the status of waters is relatively more important to local citizens because of the potentially greater role of water quality in the provision of recreational and amenity benefits. We therefore hypothesize that low water quality, large water area, and a high length of coastline would increase the propensity of municipalities to implement local environmental policies.

Furthermore, we hypothesize that municipalities with larger areas of protected natural land have a higher likelihood of implementing more stringent local environmental policies. There are larger ecological values at stake in natural reserves than on other land, and the recreational benefits provided can be considerable, motivating the need for a more ambitious local environmental policy. We hypothesize that the political pressure from higher governmental levels, due to the requirements from the WFD, implies that water quality plays a more important role in local environmental policy implementation than areas of protected natural land, where there is no corresponding EU regulation requiring, for example, a specific status of the land to be achieved at a given point in time.

The benefits of implementing local environmental policy will be higher if the population in the municipality is larger, *ceteris paribus*, because environmental quality is a public good and a greater number of people will derive utility from the environmental improvements achieved. A larger population can also imply greater pressure on water quality and environmental amenities (Granvik *et al.* 2015; COS 2016), implying that the environmental damage is greater, which further strengthens the need for developing local environmental policy. Higher average income is typically associated with a higher willingness-to-pay for environmental improvements (Barbier, Czajkowski, and Hanley 2017). If the average income is high, this also means that the municipality has a higher amount of resources and, hence, a greater capacity to pay for local environmental policy (Bulkeley and Betsill 2005; Levesque, Bell, and Calhoun 2017; Dax and Fischer 2018).

## **2.3. The need for environmental expertise**

The development of environmental targets and plans requires adequate environmental competency (Dinar, Rosegrant, and Meinzen-Dick 1997; Bulkeley and Betsill 2005).

The knowledge base for decisions could be strengthened through incorporating environmental expertise within the decision process, thereby enhancing policy outputs as well as their implementability (Newig *et al.* 2018). This can be achieved by having expertise within the staff involved in the policy work (Levesque, Bell, and Calhoun 2017), or by consulting external expertise. The choice of unit conducting policy decisions matters for the availability of expertise. If decisions are taken by managers who can be considered professional experts, mainly driven by professional ideals and career promotion, this could increase the likelihood of policies that support sustainability (Levesque, Bell, and Calhoun 2017).

Here, we consider two alternative ways for local policymakers to increase access to expertise in the development of environmental targets and plans. The first is by cooperating with the county administrative board, which typically has a considerable number of staff with professional expertise in environmental issues of different kinds (Eckerberg and Mineur 2003; Andersson, Petersson, and Jarsjö 2012). The second is for the municipal council to delegate the responsibility for the development of environmental targets and plans to committees at a lower level in the municipal organization, such as environmental or building committees. These committees have further professional expertise in their respective areas including, for example, competence in environmental, ecological, engineering, and spatial planning issues. If targets and plans are, instead, decided by the municipality board, this risks yielding slower and less appropriate outcomes (Uphoff 1992; Söderberg 2016; Warwick 2017). We therefore hypothesize that cooperation with the county administrative board, and delegation of responsibility to lower level committees positively affect the likelihood of the local government developing environmental policy.

In addition, municipalities' choice to allocate the responsibility for environmental policies to the council board or the lower level committees could itself be a variable, which is determined by the degree of complexity of the environmental issues. For example, water quality problems are typically due to pollution from known sources within the municipality, such as agriculture and wastewater treatment plants. Issues on biodiversity management are more complex, as biodiversity can only be supported by indirect measures and is strongly dependent on developments outside the municipality. The management of protected land can, therefore, require specific ecological expertise, while water quality could potentially be seen as a less complex issue. Moreover, the WFD implies pressure on local politicians to show that they engage in, and are able to comply with, the requirements posed. Taken together, municipalities with relatively large water quality problems could be expected to allocate the responsibility to the municipality council, whereas municipalities with large areas of protected land could be expected to allocate the responsibility to professional officials' level.

#### **2.4. Stakeholder participation and political representation**

Collaboration with environmental interest groups and local enterprises potentially affects the municipalities' decision on environmental policy. Such collaboration is typically seen as an important part of the policy process and is encouraged both within the framework of the WFD and by the Swedish EPA. Despite this, such collaboration is often lacking (Bäckstrand 2006; Leach 2006; Gunningham 2009). If successful, collaboration can contribute to individual and collective learning, awareness raising, policy acceptance, conflict resolution, and trust-building; however, if unsuccessful,

collaboration risks eroding trust among policymakers and stakeholders, alienating the public, and triggering new conflicts (Newig *et al.* 2018).

Environmental interest groups, which are likely to participate in collaboration, have relatively stronger preferences for high environmental quality compared to the average citizen, and are argued to be able to monitor environmental conditions, inform policymakers, and hold local politicians accountable for the situation through electoral processes (Seabright 1996; World Bank 2000; Kochskämper *et al.* 2016). We hypothesize that collaboration with environmental interest groups positively affects the likelihood of local environmental policy being developed.

Collaboration with industry and enterprises can be an obstacle to the development of local environmental policy if the companies contribute to pollution and affect land use in a way that is negative for the environment, while at the same time, policymakers are concerned about the economic viability of the enterprises in question (Cropper *et al.* 1992; Eckerberg 1997; D'Uva 2017). The agricultural sector is a major source of water pollution, and the WFD has increased demands for farmers to reduce the release of nutrients into watercourses (Andersson 2004). Locally issued restrictions on farmers' practices are generally not entitled to compensation and can, therefore, be expensive for farmers. Ambiguities also exist within locally developed demands placed on farmers which further hampers support amongst the farming community (Christensen and Kørnøv 2011). This suggests that farmers could be inclined to resist increased stringency of local environmental policy.

Environmentally oriented political parties can also act to increase the stringency of local environmental policy (e.g., Levesque, Bell, and Calhoun 2017). In the Swedish context, the Center Party and the Green Party are typically characterized as more environmentally oriented than other parties (Brandt, Burström, and Frostell 1999; Jamison 2003; Carter 2007; Linde 2010). Both parties, arguably, prefer more decentralized environmental policy with goal setting and monitoring to be carried out at the local level (Kirchgässner and Schneider 2002, Linde 2010). Political ideology differences between the two parties are a point of discussion, where the Green Party often has positions ranging from the middle to left of the right-left spectrum (Bennulf and Holmberg 1990; Jahn 1993; Folke 2014), while the Center Party has a history of cooperation with both conservative and left-wing parties on the municipal level (Bennulf and Holmberg 1990; Jahn 1993; Folke 2014). The Center Party tends to resist direct controls for environmental problems issued at the national level, whilst compromising locally with left parties based on local conditions (Goldfield 1982). We therefore hypothesize that a higher proportion of elected municipal council officials from these two parties is associated with a higher level of environmental policy implementation.

In addition, political representation could affect the decision to allocate responsibility for environmental policy to the municipal board or professional officials. When policies are decided by politicians who rely on political support to be re-elected, the politicians may be inclined to prefer policies that improve the conditions for important voter groups and the reputation of the politician (Levesque, Bell, and Calhoun 2017). Policies decided by lower level committees may receive less attention among the local voters, compared to policies developed by the municipal council itself. Due to the lower visibility, decisions by lower level committees might not enhance the prospects for re-election of politicians belonging to parties placing strong emphasis on environmental issues. Thus, delegation may be less preferred by parties for which it is



important to show their voter groups that they contribute to the development of environmental policy. We therefore hypothesize that a larger representation of parties with a green profile increases the likelihood that environmental policy decisions are taken by the municipal board.

### 3. Model and data description

We are interested in studying the adoption of local environmental targets and plans, which could be decided separately or jointly. For this purpose, we first use logistic (logit) regressions to analyze the municipalities' choices of whether to introduce local environmental goals and action plans, treating these as separate decisions. Subsequently, we categorize municipalities regarding whether they have adopted both local targets and plans, only one of these, or none. These categories can be viewed as indicating different levels of ambition. We employ a multinomial logit model estimation to analyze factors that explain the category to which municipalities belong. The choice to allocate the responsibility for decisions to the political or manager level is a binary one and is analyzed using a logistic regression.

#### 3.1. Modelling approach

The logit model employed employs certain sets of binary outcome variables, denoted by  $y_i$ , such that:

$$y_i = \begin{cases} 1 & \text{with probability } p \\ 0 & \text{with probability } 1-p \end{cases} \quad (1)$$

Here, the binary outcome variables have been obtained from a survey carried out by the Swedish Association of Local Authorities and Regions (SKL 2012) detailing decisions on environmental policy made by Swedish municipalities. Specifically, regressions are conducted to investigate choices by municipalities on whether to introduce local environmental goals, denoted by 'Goal', local action plans, denoted by 'ActionPlan', and whether to allocate the responsibility for these to a given municipal body, denoted by 'Responsibility'. These three policy variables are all dependent variables in our regressions. The likelihood of a decision outcome is estimated using the following logistic regression model:

$$\begin{aligned} \text{logit}[P(Y_{ij} = 1)] = & \alpha + \beta_1 \text{Oxy}_j + \beta_2 \text{WArea}_j + \beta_3 \text{NRArea}_j + \beta_4 \text{Coast}_j + \beta_5 \text{Pop}_j \\ & + \beta_6 \text{AvInc}_j + \beta_7 \text{Responsibility}_j + \beta_8 \text{County}_j + \beta_9 \text{IntGroups}_j + \beta_{10} \text{Business}_j \\ & + \beta_{11} \text{Farms}_j + \beta_{12} \text{FArea}_j + \beta_{13} \text{Center}_j + \beta_{14} \text{Green}_j + \varepsilon_i \end{aligned} \quad (2)$$

where  $Y_{ij}$  denotes the municipal decision for measure  $i$ , where  $I =$  'Goal', 'ActionPlan', 'Responsibility', in municipality  $j$ . For example, if municipality  $j$  has adopted their own local environmental goals,  $Y_{ij}$  equals one if the municipality has adopted a local goal, and zero if not. We include environmental, socioeconomic, environmental expertise, as well as stakeholder participation and political representation as explanatory variables. The environmental variables included are: the average dissolved oxygen concentration in water bodies, 'Oxy', where a higher oxygen concentration indicates better water quality<sup>2</sup> (Kannel *et al.* 2007; Sánchez *et al.* 2007); total surface water area, 'WArea'; the total area of nature reserve land, 'NRArea'; and the coastal

length for each municipality, ‘Coast’. In addition to these, we also consider socio-economic conditions through the inclusion of population, ‘Pop’, and average per capita income, ‘AvInc’.

The effect of environmental expertise is accounted for by including a binary variable for cooperation with the county administration, ‘County’, and by considering whether the decision to adopt goals and plans is affected by the assigned responsible body, reflected in the binary variable ‘Responsibility’.<sup>3</sup> Finally, a number of variables are included reflecting the involvement of stakeholders in policy development, including binary variables for collaboration with interest groups, ‘IntGroups’, and the business sector, ‘Business’. Furthermore, we include the number of farms within the municipality, ‘Farms’, and the area of agricultural land, ‘FArea’, where both are assumed to be proxies for the political power of the agricultural industry. We also test the effects of political representation within the municipal council of the Center Party, denoted by ‘Center’, and the Green Party, denoted by ‘Green’ as a proxy for their influence on policy development.

For each explanatory variable we calculate the marginal effects which show the effect on the likelihood of each different outcome from a change in the explanatory variables. These are obtained through measuring the partial derivative w.r.t. for each explanatory variable given by the expression:  $\partial p / \partial x_j$ .

Subsequently, a multinomial logit estimation is conducted where we simultaneously consider the choice to introduce goals and action plans. This multinomial logit estimation is modelled with three levels in the response variable. Using the example of estimating the choices for the dependent variable ‘Goal’ based on the choice for ‘ActionPlan’, this can be visualized as seen below in Equation (3):

$$\begin{aligned} \text{Group 3} &= \text{‘Yes’ for Goal and ‘Yes’ for ActionPlan} \\ \text{Group 2} &= \begin{cases} \text{‘Yes’ for Goal and ‘No’ for ActionPlan} \\ \text{‘No’ for Goal and ‘Yes’ for ActionPlan} \end{cases} \\ \text{Group 1} &= \text{‘No’ for Goal and ‘No’ for ActionPlan} \end{aligned} \quad (3)$$

Here, Group 1 is given as the reference label (or base outcome). The econometric equation can thus be given as

$$\begin{aligned} \ln \left[ \frac{P(Z_{ij} = 3)}{P(Z_{ij} = 1)} \right] &= \alpha + \beta_1 \text{Oxy}_j + \beta_2 \text{WArea}_j + \beta_3 \text{NRArea}_j + \beta_4 \text{Coast}_j + \beta_5 \text{Pop}_j \\ &+ \beta_6 \text{AvInc}_j + \beta_7 \text{Responsibility}_j + \beta_8 \text{County}_j + \beta_9 \text{IntGroups}_j + \beta_{10} \text{Business}_j \\ &+ \beta_{11} \text{Farms}_j + \beta_{12} \text{FArea}_j + \beta_{13} \text{Center}_j + \beta_{14} \text{Green}_j + \varepsilon_i \end{aligned} \quad (4)$$

where  $Z_{ij}$  is the multinomial policy choice as explained above. The same principle is also used for  $P(Z_{ij} = 2)$  with  $P(Z_{ij} = 1)$  being the base outcome. From this estimation, we calculate the marginal effects from each multinomial group, see Equation (3).

### 3.2. Description of the data – dependent variables

Our dependent variables were obtained from a survey<sup>4</sup> of 270 Swedish municipalities carried out in 2011. The dependent variables in the logistic regressions are all binary. The variable ‘Goal’ takes a value of 1 when the municipality has developed their own local environmental goals and 0 otherwise. For the second dependent variable,

'ActionPlan', a value of 1 indicates that the municipality has adopted an action plan, and 0 otherwise. Finally, for the third dependent variable, 'Responsibility', a value of 1 indicates that the main responsibility for environmental goals lies with the municipal council board, and 0 that the responsibility lies with lower level committees, for example, is delegated to the environment and building committee, the municipal building board, or some other committee.

### 3.3. Description of the data – explanatory variables

Data for the environmental, socioeconomic, and political variables were obtained from publicly available sources, and apply to the year 2011. Environmental data includes data on dissolved oxygen content in surface water bodies, 'Oxy', collected from the Environmental Database<sup>5</sup> managed by the Swedish University of Agricultural Sciences. We use the dissolved oxygen content, measured in mg O<sub>2</sub>/l, averaged over all monitoring stations in the municipality over the year 2011. Data for the water area, 'WArea', and nature reserve area, 'NRArea', measured in km<sup>2</sup> and hectares, respectively, were collected from the Statistics Sweden (SCB) database. Finally, data for the coastal length of each municipality, 'Coast', was collected from the SCB database and is measured in kilometers. Population, 'Pop', and average net income<sup>6</sup> per capita in thousand SEK<sup>7</sup> within the municipality among citizens aged 16+ per year, 'AvInc' were collected from the SCB<sup>8</sup> database.

Regarding expertise, data on the interaction with the county administration were obtained from the SKL survey and reflects whether the county administration have assisted the municipality when developing targets and action plans. The variable 'County' takes a value of 1 when the municipality was assisted by the county administration, and 0 otherwise.

Data on stakeholder involvement, including collaboration with local interest groups ('IntGroups') and local private businesses ('Business'), have been obtained from the SKL survey, and are binary variables. The variables take a value of 1 when there has been collaboration, and 0 otherwise. Data on the number of farms, 'Farms', are as of 2010 which is the nearest available year. These, as well as the data on farm area, 'FArea', were collected from the Swedish Board of Agriculture.<sup>9</sup>

Data on political representation of the Swedish Center and Green parties were collected from the Swedish Election Authority,<sup>10</sup> and expresses the share of seats in the municipal council. Elections are held every fourth year, and data expresses the situation after the election in 2010. A summary of descriptive statistics for each variable discussed can be seen in [Table 1](#).

## 4. Results

This section details the results from estimations of the empirical model and the associated marginal effects. For each dependent variable, three models are estimated: Model 1 includes the main environmental and socioeconomic variables, Model 2 also includes variables reflecting the inclusion of expertise in the policy process, that is, cooperation with the county administration as well as the variable 'Responsibility' for the estimations with 'Goal' and 'ActionPlan' as dependent variables. Finally, Model 3 adds stakeholder variables: collaboration with interest groups and local business, the number

of farms, the area of farm land, and representation of the Center and Green parties on municipal council boards.

For logged values, percentage changes are obtained by converting from logarithmic forms. When multiple models display significance, we focus the discussion on the estimated effect in the model that includes the greatest number of available explanatory variables, which has also (in all cases) the highest score for the quality of the model, represented by the lowest Akaike information criterion (AIC) value, as seen in the [Appendix](#), Tables A1, A2, A3 and A4 ([online supplemental data](#)), which display results from the initial logistic and multinomial logistic regressions. The section concludes with post-estimation checks.

#### **4.1. When do municipalities have environmental goals?**

Water quality matters for municipalities' choice to adopt environmental goals. The marginal effect of dissolved oxygen content (Oxy) on 'Goal' is significant at the 1% level in Models 1 and 2, but at the 5% level in Model 3, see [Table 2](#). With a negative sign, this implies that as the oxygen level increases by 1 mg/l O<sub>2</sub>, the likelihood of adopting local environmental goals decreases by 0.077%, from Model 3. No significance is observed for population, the area of water and nature reserve land, or coastal length.

A less robust outcome is seen for average income as 'AvInc' is significant at the 5% level within Models 1 and 2, but loses significance when adding stakeholder variables. From Model 2, results suggest that an increase in average income by 1,000 SEK would lead to an increased likelihood of 4.2% of adopting local environmental goals. This would imply that higher income increases the likelihood of adopting local goals. No statistical significance is observed for the variables reflecting the inclusion of expertise.

Considering collaboration with stakeholders, the marginal effect of 'IntGroups' is significant at the 1% level in Model 3. With a positive coefficient, this implies that cooperation with local organizations and interest groups increases the likelihood of adopting local environmental goals by 0.27%. Furthermore, the number of farms is significant at the 5% level. With a negative coefficient, this implies that an increase by one farm would lead to a decreased likelihood of 1.29% for adoption of goals. The surface area of farmland is also significant at the 10% level. With a positive coefficient, this implies that an increase in farmland by 1 km<sup>2</sup> increases the likelihood by 1.17%. No significance is observed for collaboration with businesses or political representation of the Center and Green parties.

#### **4.2. When do municipalities have local environmental action plans?**

Water quality also matters for municipalities' choice to adopt action plans. The marginal effects of dissolved oxygen content are significant at the 1% level in Models 1 and 2 and at the 10% level in Model 3, see [Table 2](#). From Model 3, with a negative sign, this implies that as the oxygen level increases by 1 mg/l O<sub>2</sub>, this causes a decrease in the likelihood of having an action plan by 0.06%. No significance is observed for the area of water and nature reserve land, coastal length, or population levels.

As for 'Goal', a less robust result is seen for average income where results show significance at the 5% and 10% level in Models 1 and 2, respectively, implying that

Table 1. Descriptive statistics.

Variable	Obs	Mean	Median	Std. Dev.	Min	Max
'Goal'	240	0.60	1	0.49	0	1
'ActionPlan'	239	0.36	0	0.48	0	1
'Responsibility'	233	0.73	1	0.44	0	1
Oxygen content (mg/l) (Oxy)	175	9.35	9.47	1.31	6.52	12.97
Surface area of water (WArea) (km <sup>2</sup> )	270	416.39	137	940.14	0	12 180
Surface area of natural reserve land (NRArea) (ha)	270	13,357	1,894	63,540	0	557,366
Coastal length (Coast) (km)	270	38.94	0	94.56	0	531
Population (Pop)	270	33,892	15,662	68,070	2,431	864,324
Average per capita income (AvInc) (kSEK)	270	202.32	195	31.27	162	496
'County'	231	0.92	1	0.27	0	1
'IntGroups'	223	0.76	1	0.43	0	1
'Business'	221	0.73	1	0.44	0	1
Number of farms (Farms)	270	247	193	216	0	1,574
Surface area of Ag. Land (FArea) (ha)	270	10,794	7,228	12,440	0	111,132
Center (%)	270	11.22	8.89	0.08	0	38.71
Green (%)	270	4.95	4.88	0.03	0	17.07

an increase in average income by 1,000 SEK increases the likelihood of an action plan by 2.3% (given in Model 2). As with 'Goal', no statistical significance is seen for the variables concerning expertise.

The marginal effects of collaboration with interest groups is significant at the 5% level. With a positive coefficient, this implies that the presence of such collaboration increases the likelihood of having adopted an action plan by 0.27%. No significance is observed for collaboration with businesses, the number of farms, area of farmland, as well as political representation of the Center and Green parties.

#### 4.3. When do municipalities have both local environmental goals and action plans?

When local environmental goals and action plans are considered as a joint decision, see Equation (4), results indicate an even stronger role for environmental conditions, see Table 3. Oxygen content is significant at the 1% level within Models 1 and 2 and at the 5% level for Model 3 within Group 1, where this group has neither goals nor an action plan. With a positive coefficient, this implies that an increase in the oxygen level of 1 mg/l O<sub>2</sub> increases the likelihood by 0.06% (from Model 3) of being in the least ambitious group of municipalities. For Group 3, the most ambitious group, we observe statistical significance at the 1% level within Models 1 and 2, but at the 5%

Table 2. Logistic regression – marginal effects on ‘Goal’ and ‘ActionPlan’.

	‘Goal’			‘ActionPlan’		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Oxy	<b>-0.077***</b>	<b>-0.077***</b>	<b>-0.071**</b>	<b>-0.081***</b>	<b>-0.080***</b>	<b>-0.059*</b>
WArea (log)	-0.034	-0.027	-0.001	0.038	0.031	0.035
NRArea (log)	0.036	0.033	0.022	-0.024	-0.009	-0.014
Coast	0.001	0.001	0.001	0.001	0.001	0.001
Pop (log)	0.026	0.006	0.090	0.042	0.023	0.053
AvInc (log)	<b>1.290**</b>	<b>1.434**</b>	0.914	<b>0.858**</b>	<b>0.847*</b>	0.552
Responsibility		-0.041	-0.067		0.012	0.052
County		-0.007	-0.009		-0.148	-0.153
IntGroups			<b>0.273***</b>			<b>0.271**</b>
Business			-0.064			0.005
Farms (log)			<b>-0.254**</b>			-0.014
FArea (log)			<b>0.157*</b>			-0.044
Center			1.003			-0.241
Green			-1.925			-2.259

Note: \* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$ .

level within Model 3. With a negative coefficient, this would imply that an increase in the oxygen level by 1 mg/l O<sub>2</sub>, decreases the likelihood of being in Group 3 by 0.06% (from Model 3).

Different to the foregoing estimations, the multinomial model suggests that the length of the coastline matters. Coastline is significant at the 5% level within Models 1–3 for Group 3. With a positive coefficient, this implies that adding 1 km to the coastline increases the log-odds of a municipality being in Group 3 by 0.001%.

Average income is significant at the 5% level for Group 1 in Models 1 and 2 and at the 10% level in Model 3, see Table 3. With a negative coefficient, this implies that an increase in average income by 1,000 SEK would decrease the likelihood of being in the least ambitious group by 3.06% (from Model 3). Significance at the 5% level is also observed for Group 3 in Models 1 and 2. With a positive coefficient, this implies that as the level of average income increases by 1,000 SEK, the log-odds likelihood of being in the most ambitious group increases by 2.67% (from Model 2). No significance is observed for population levels, the area of water or nature reserve land, or variables concerning expertise.

Results are significant at the 1% level in all models for ‘IntGroups’ within Group 1, see Table 3. With a negative coefficient, this implies to us that cooperation with interest groups reduces the likelihood of being in the least ambitious group by -0.27%. For Group 3, results are significant at the 5% level. The positive coefficient implies that cooperation with interest groups increases the log-odds likelihood of being in the most ambitious group by 0.42%.

As seen in Table 3, representation of the Center Party is significant within Group 1, at the 10% level. A higher share of Center Party representation implies a decreased likelihood of 1.02% for being within Group 1, where municipalities have neither local goals nor action plans. Significance is also seen for representation of the Center Party within Group 2 at the 5% level. Here, a higher share of Center Party representation implies an increased likelihood of 1.51% for being within Group 2, where municipalities have either local goals or action plans. No significance is observed for the remaining variables.

Table 3. Multinomial logistic regression – marginal effects on the combination of ‘Goal’ and ‘ActionPlan’.

	Model 1	Model 2	Model 3
<b>Group 1</b>			
–Oxy	<b>0.067***</b>	<b>0.075***</b>	<b>0.059**</b>
WArea (log)	–0.001	0.000	–0.018
NRArea (log)	0.004	–0.004	0.002
Coast	–0.000	–0.000	–0.000
Pop (log)	–0.013	0.016	–0.071
AvInc (log)	<b>–1.452**</b>	<b>–1.621**</b>	<b>–1.118*</b>
Responsibility		0.040	0.056
County		–0.097	–0.113
IntGroups			<b>–0.274***</b>
Business			–0.005
Farms (log)			0.170
FArea (log)			–0.100
Center			<b>–1.016*</b>
Green			2.331
<b>Group 2</b>			
Oxy	0.028	0.012	0.001
WArea (log)	–0.010	–0.017	–0.008
NRArea (log)	–0.025	–0.019	–0.020
Coast	–0.001	–0.001	–0.001
Pop (log)	–0.019	–0.033	0.018
AvInc (log)	0.512	0.639	0.785
Responsibility		–0.055	–0.114
County		0.310	0.364
IntGroups			–0.148
Business			0.125
Farms (log)			–0.093
FArea (log)			0.095
Center			<b>1.508**</b>
Green			–0.234
<b>Group 3</b>			
Oxy	<b>–0.095***</b>	<b>–0.087***</b>	<b>–0.060**</b>
WArea (log)	0.010	0.017	0.027
NRArea (log)	0.021	0.023	0.018
Coast	<b>0.001**</b>	<b>0.001**</b>	<b>0.001**</b>
Pop (log)	0.033	0.017	0.053
AvInc (log)	<b>0.940**</b>	<b>0.982**</b>	0.334
Responsibility		0.015	0.058
County		–0.213	–0.252
IntGroups			<b>0.422**</b>
Business			–0.120
Farms (log)			–0.076
FArea (log)			0.004
Center			–0.492
Green			–2.097

Note: \* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$ .

#### 4.4. Who is selected as responsible for goals and action plans?

In Model 1, the impact of water quality on the choice to place the responsibility with the municipal board is significant at the 10% level, see Table 4. However, the effect is

Table 4. Logistic regression – marginal effects on ‘Responsibility’.

	Model 1	Model 2	Model 3
Oxy	<b>-0.049*</b>	-0.044	-0.035
WArea (log)	0.012	0.012	0.027
NRArea (log)	-0.009	-0.003	-0.026
Coast	0.001	0.001	0.001
Pop (log)	-0.012	-0.015	0.010
AvInc (log)	0.466	0.610	0.293
County		-0.153	-0.131
IntGroups			0.012
Business			0.013
Farms (log)			<b>-0.157*</b>
FArea (log)			<b>0.143*</b>
Center			<b>1.815***</b>
Green			2.481

not significant in Models 2 and 3. Based on Model 1, an increase in the oxygen level by 1 mg/l O<sub>2</sub> would imply a decrease in the likelihood of -0.05% for assigning the responsibility to the municipal board. No significance is observed for the other socio-economic or environmental variables, as well as for collaboration with the county administration.

Results indicate that the number of farms is also significant at the 10% level. With a negative sign, this implies that an increase of one farm within a municipality reduces the likelihood by 1.17% of allocating responsibility to the municipal council board. Furthermore, the area of farmland is significant at the 10% statistical level. With a positive sign, this implies that an increase in farmland by 1 km<sup>2</sup> increases the likelihood by 1.15% of allocating responsibility to the municipal council board.

Results indicate that higher political representation of the Center Party positively affects the likelihood of allocating the responsibility to the municipal board, where an increase of 1% in representation of the Center Party is associated with an increased likelihood of 1.82% for responsibility being with the municipal board. No significance is observed for the remaining variables.

#### 4.5. Post-estimation tests

To measure how well the models employed fit with the data, we applied the Hosmer-Lemeshow goodness-of-fit test (see [Appendix, Table A5 \[online supplemental data\]](#)) which orders the observed data within equally sized groups and then tests whether the observed event rates match the expected event rates within these subgroups. This is used instead of the more commonly employed Pearson goodness-of-fit test as the number of covariate patterns is close to the number of observations which would make the applicability of the Pearson test questionable (Hosmer, Lemeshow, and Sturdivant 2013). Results for the multinomial logit estimation use the multinomial version of the Hosmer-Lemeshow goodness-of-fit test detailed in Fagerland and Hosmer (2012), see [Appendix, Table A6 \(online supplemental data\)](#). Here, a significant result from the Chi<sup>2</sup> statistic would indicate that the model does not have goodness of fit and that there may be misspecification of the model. From the results presented, we see that no significant results are seen for any of the estimations. This indicates to us that we



cannot reject our chosen model for any estimation, indicating that our model fits reasonably well.

To test for multicollinearity, we constructed a correlation matrix, see [online supplementary material](#), Table S1. This matrix shows low correlation between variables, with the highest correlation standing at 0.55. Furthermore, the centered variance inflation factors never exceed 10 for our estimations. Hence, we can conclude that our data does not suffer from multicollinearity issues. Finally, also as a robustness check, probit models were estimated, and results were similar to those presented above. Furthermore, certain municipalities have particularly high levels of average income, coastal length, or surface water area. To test whether the presence of outliers affected the above results, we implemented a winsorization of the data in order to remove data points that fall within the upper and lower 1% range. The results for the multinomial logit estimation with winsorized data are presented in the [online supplementary material](#), Table S2. From these results, only two notable changes are seen; representation of the Green Party is significant at the 10% level within Group 1, with a positive coefficient, but no significance is seen for representation of the Center Party in Group 1. Further results for all estimations, however, are similar with and without winsorized data, implying that outliers do not have a significant impact on our results.

## 5. Discussion and conclusions

We hypothesized that the choice to implement local environmental goals and action plans was strongly affected by surface water quality, as well as by the surface water area and coastal length. Results showed that, out of these, water quality, proxied by the dissolved oxygen concentration, had the strongest effect, being significant in all estimated models. Hence, municipalities with poor water quality are more inclined to adopt local environmental targets and action plans. However, the magnitude of the effect of dissolved oxygen concentration and coastal length is relatively small. Still, this result illustrates the observation by Thomann and Sager (2017) that diversity is inherent in EU implementation, where a one-size-fits-all solution to effective policy implementation is not appropriate. In this case, a non-uniform implementation of the WFD, in terms of differences in the development of local environmental targets and plans, is rational from a societal perspective given the variations in the severity of water quality degradation across municipalities.

Furthermore, coastal length was significant with respect to explaining municipalities' choice to have both goals and action plans. This is consistent with national aims to meet common water quality targets for the Baltic Sea in a cost-efficient manner, as the impact of measures at sources close to the coast is higher than for upstream sources, implying that the cost of reducing coastal load is lower for the coastal sources (Balana, Vinten, and Slee 2011; Rygaard, Binning, and Albrechtsen 2011).

Second, our results show that income, but not population numbers, is significant in most of the models. Population numbers indicate the size of the social gains from environmental policy, whereas income rather indicates the willingness and ability to pay for these gains. Furthermore, higher income can also be associated with higher administrative capacity to effectively develop plans and goals. The sizable effect of income raises the question of the fairness of the observed pattern of environmental policy implementation, as it shows that high-income municipalities provide their citizens with better environmental quality (cf. Söderberg 2016). This is not consistent

with the requirements posed by the WFD, which demands water quality policies to be based on environmental quality. Our results for income are in line with findings in Grafton and Knowles (2004), who studied the role of social and economic factors for countries' performance with respect to a water quality index, and Elofsson and von Brömssen (2017), where income is shown to positively affect the likelihood of having goals defined for agricultural measures that reduce nutrient loads. It is argued that a strongly decentralized and, hence, non-uniform policy can perform well if local governments have a strong autonomy (Oates 2001; Thomann and Sager 2017), such as is claimed to be the case in Sweden (Jörby 2002; Hysing 2009). However, our results suggest that such autonomy is not sufficient to secure fair outcomes or maximization of welfare on the national level.

We hypothesized that the presence of environmental expertise in the policy process matters for policy development. Contrary to expectations, we did not find any significant effect of collaboration with the county board. Neither did we find any evidence that the decision to allocate the responsibility to lower level committees with a stronger role for professionals mattered for the outcome.

The results indicate that stakeholders affect local environmental policy implementation. As expected, municipalities with more farms are less inclined to adopt local environmental goals, while a larger area of farmland has the opposite effect. The first effect was expected and has support from Andersson (2004) which claims that greater agricultural activity in a municipality could be negatively correlated with the implementation of local environmental policy, because the interest of farmers does not necessarily coincide with that of other municipal citizens. The latter effect was unexpected, and our interpretation is that a large farm area might be positively related to both the political influence of the farm industry, and to environmental impacts, making the effect on policy implementation ambiguous. In summary, we are not able to draw any strong conclusions regarding the impact of the farming industry on environmental policy.

Furthermore, municipalities that collaborate with local interest groups were more inclined to adopt local environmental targets and action plans, which is in line with observations in previous literature, where further collaboration is argued to increase the capacity to evaluate environmental conditions and monitor progress (Bäckstrand 2006; Leach 2006; Gunningham 2009; Levesque, Bell, and Calhoun 2017). However, we cannot rule out the possibility that the causal relationship could be the opposite: the initiation of goal and plan development might have led to collaboration, in that interest groups were invited to participate in drafting those documents.

We also see that municipalities that have higher representation from the Center Party are less likely to adopt both national targets and action plans, but a higher likelihood of adopting either a goal or an action plan. The observation that a higher representation of the Center Party implies a moderately ambitious environmental policy fits with previous literature (Goldfield 1982; Kirchgässner and Schneider 2002; Folke 2014) where the party is shown to have a history of compromise at the local level.

Furthermore, we investigated municipalities' choice to place responsibility for environmental policy with the municipal council board or a lower level committee. Results suggest that municipalities with a larger area of farmland but fewer numbers of farms, hence with larger farms, have a higher propensity to place the responsibility with the municipal council, hence making the policy process a political rather than an administrative issue. This could potentially imply a stronger role in the policy process

for concerns for the economic viability of the farm industry (cf. Eckerberg 1997). Finally, municipalities with higher representation of the Center Party within the municipal council are more inclined to assign responsibility for environmental goal setting with the municipal council. This result fits in with predictions made by earlier literature (Kirchgässner and Schneider 2002), where the Center Party is ideologically motivated through their aims for decentralized governance (Linde 2010). In comparison, we observe no statistical impact from Green Party representation. This contrasts with observations in Folke (2014), who concludes that the party's representation has a considerable impact on a regularly produced survey-based environmental ranking of municipalities. The difference in results could be due to methodological differences, where Folke (2014) investigates the effect of the marginal seats allocated to parties in the municipal council, where the allocation of those seats is treated as random, while environmental and socioeconomic conditions are not accounted for. Given the observation from this study that such conditions matter for policy implementation, future studies aiming to study party effects could benefit from combining the approaches.

Important limitations of our study include the use of cross-sectional data, and the exclusion of spatial effects in local policy development. Both causality and spillovers could be further explored with panel data, and efforts to develop such datasets would, therefore, be valuable.

Based on our results, we recommend that national policy makers further consider whether fairness and compliance with the uniform water quality requirements posed by the WFD, should be prioritized above economic efficiency. If fairness and WFD requirements are seen as more important, this needs to be further addressed in the policy design.

## Notes

1. Taken as part of an overall study conducted with results in SKL (2012).
2. Alternative measures of water quality, such as phosphorus (P) and nitrogen (N) content, were not included because they cannot be seen as independent from dissolved oxygen content (Carpenter *et al.* 1998), and, hence, estimates from logit would be imprecise (Woo *et al.* 2014).
3. For the regressions with 'Responsibility' as a dependent variable, the same variable is excluded from the right-hand side of Equation (2).
4. The survey questions can be found in the [online supplementary material](#).
5. Available at [www.miljodata.slu.se/mvm/](http://www.miljodata.slu.se/mvm/).
6. Net income is the sum of an individual's all taxable and tax-free income less taxes and other negative transfers (such as repaid student loans).
7. 1 SEK = 0.11 EUR, according to Riksbank statistics (2011) for annual average exchange rates.
8. Statistics Sweden – [www.scb.se](http://www.scb.se).
9. Board of Agriculture – [www.jordbruksverket.se](http://www.jordbruksverket.se).
10. Swedish Election Authority – [www.val.se](http://www.val.se).

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## Supplemental data

Supplemental data for this article can be accessed [here](#).

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