Characteristics of active local water management districts in the Red River Basin

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Abstract

As new demands for water management emerge, water managers need to evolve and accept new roles and new ways of working. Local water management districts with traditional water quantity roles need to adopt new activities and new ways of working in order to support basin-wide water quality and flood control initiatives. This paper presents an empirical analysis of the adoption of twenty-two activities and strategies by local water management districts in the Red River of the North basin in Minnesota and North Dakota. A variety of explanatory characteristics of districts and district boards are assessed. Empirical analysis does not demonstrate a dramatic difference between Minnesota districts and those in North Dakota, nor a remarkable difference between upstream and downstream districts. Board member characteristics have significant influence on local water management district activities and institutional arrangements.

Keywords: Adoption; Conservation districts; Institutional evolution; Red River of the North; Water resource management; Watershed districts

Introduction

Society is evolving and water managers need to expand their programs and activities. Previous priorities, such as security of potable water delivery, remain critical, but new demands for water quality have emerged. Water managers need to diversify away from infrastructure development and water storage and movement projects, towards water quality, habitat preservation and recreation development activities. As new demands for water management emerge, institutions and organizations need to meet these needs. Either new institutions need to be developed or existing institutions need to evolve and accept new roles.

With increasing efforts to reduce non-point source pollution to maintain water quality, new attention is needed to assess local land and water management agencies. These local natural resource managers need to ensure that local communities receive traditional water management services, such as potable


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water protection, drainage and flood protection. But they also serve as the agencies in place to serve more recent needs, such as water quality and habitat protection and recreation development. These agencies are best suited to implement efforts to control nonpoint source pollution from agricultural and urban runoff because they serve the landowners and are needed to cooperate in nonpoint pollution control efforts.

There is a diverse population of local water management districts (LWMDs) in the Red River of the North (Red River) Basin. Along with federal and state agencies tasked with water and natural resources management, these LWMDs are responsible for the needs of local constituencies. These LWMDs include conservation districts (CDs) in North Dakota and Minnesota, water resource districts in North Dakota (WRDs) and watershed districts in Minnesota (WDs). Together with tribal departments of natural resources, township and municipal city water supply and nongovernmental interest groups, these LWMDs attempt to manage water resources to maximize residents’ quality of life without excessively infringing on current and future water needs.

The CDs, WRDs and WDs have powerful legislative mandates to regulate water use and discharges, to develop infrastructure and involve themselves in many aspects of water management. Many of these LWMDs have the power to levy taxes and special assessments on property owners. In general, these local governmental districts evolved from districts that were formed in the 1930s to meet the needs of those times, especially drainage and soil conservation (Hearne, 2007). However, there remain concerns that these LWMDs need to evolve further in order to provide services that meet the growing demand for ecosystem protection, nonpoint source pollution reduction and recreation development.

Institutional evolution of LWMDs would imply the acceptance of new roles and functions, such as water quality monitoring and ecosystem preservation. It would also imply the acceptance of alternative institutional arrangements in order to share resources, reduce costs, compete for external funding, adjust to new state and federal policies and accept responsibilities beyond jurisdictional boundaries. These alternative arrangements include joint powers agreements and collaboration on certain projects.

In terms of water management, one important innovation is management by hydrological boundaries instead of political boundaries. Indeed, in Minnesota, efforts were made to develop watershed districts throughout the eastern part of the Red River Basin. These are local units of government, but they conform to hydrological units and not counties. In North Dakota the legislative authorization for WRDs specifies that these districts are to be delineated along hydrological boundaries. But the de facto districts conform to county boundaries. However, there are a number of joint powers agreements between North Dakota’s county WRDs to support joint management and collaboration of the Upper Sheyenne River, the Red River and Devils Lake.

Because circumstances vary across geographical areas and political boundaries, institutional evolution does not imply that all LWMDs should be alike, even in the same river basin. It is very possible that hydrologically delineated watershed districts in Minnesota serve the needs of Minnesota well, while county-based water resource districts in North Dakota serve North Dakota well. No single organizational arrangement should be accepted as the best arrangement across a variety of needs and circumstances. Indeed the variety of institutional arrangements allows new ideas to be developed and more cross agency learning.

One means of assessing how these LWMDs are evolving is to assess their adoption of new activities, new institutional arrangements and alternative sources of income. Neither the acceptance of new roles and activities, the willingness to collaborate with other organizations, nor the successful application for external grant funding implies that a LWMD is successful. In some geographical and political
circumstances it might be preferred to maintain a “do little, spend little and leave well enough alone” attitude. However, those LWMDs that have been willing to evolve are most likely to be those that will continue to accept the new challenges that are presented to them. And the characteristics of LWMDs that do adopt new activities are the characteristics that can be fostered by those state and federal agencies that would like to promote dynamic local water management.

Empirical analysis of LWMDs and the broader population of water management organizations remains scarce. Much of the literature remains descriptive, with numerous case studies. Leach & Pelkey (2001) performed a review of studies that address conflict resolution in watershed partnerships and concluded that secure funding is the most identified factor of success among water management organizations. Clark et al. (2005) assessed the characteristics of watershed organizations across the United States and identified regional patterns that may facilitate linkages. Draeger (2001) assessed the effectiveness of assorted Minnesota water management organizations. Staffing, planning and citizen participation were positively correlated with effective organizations. Recently, Nachbaur (2008) used panel data to assess the adoption of groundwater districts in Texas and concluded that drought, energy prices and population increases contributed to jurisdictions that form groundwater districts.

Policy makers, state and federal agencies and LWMDs managers and directors need to understand the characteristics of LWMDs that have adopted new activities and collaborations. Through adoption, this study presents a mechanism to assess empirically institutional evolution. This paper will present an analysis of the characteristics of CDs, WRDs and WDs in the Minnesota and North Dakota portions of the Red River Basin that have adopted a variety of activities or institutional arrangements. Data collected from these agencies and from their board members will be assessed in order to identify the relationship between a variety of characteristics of the organization and their boards and a series of activities. The second part of this paper will present some pertinent background on water management in the Red River Basin. The subsequent sections will present the methods and results of an analysis of the adoption of pertinent management activities and institutional arrangements. The conclusions will address the implications of these results.

Background

The Red River Basin was once part of the large glacial Lake Agassiz and encompasses about 117,000 km² in Minnesota, North Dakota, South Dakota and Manitoba. Wahpeton/Breckinridge, Fargo/Moorhead and Grand Forks/East Grand Forks are the major urban areas in the United States’ portion of the Red River, while Winnipeg is the main city in Manitoba, see Figure 1. These communities contain the majority of basin residents. Owing to the Red River’s topography, the valley is home to some of the richest, most fertile and flattest farmland in the United States. The main crops in the basin are spring wheat, sugar beet, barley, sunflowers, potatoes, corn and soybean (Krenz & Leitch, 2003; Minnesota Pollution Control Agency, 2006).

The slope of the river is relatively mild. Over a distance of roughly 880 km, this is only a 0.10 m drop in elevation per kilometer. The width of the Red River Basin has the same elevation characteristics, but not quite as drastic. Owing to small changes in altitude, the Red River expands dramatically during flood stage. During the flood of 1997, portions of the Red River in Manitoba reached a width of 40 km (Fritz, 2003). Flooding, drainage and drought are the traditional water concerns in the Red River Basin. Owing to the flat topography, flooding causes damage over a large area and drainage systems are required to allow
crop production on flooded fields. The flat slope of the basin would cause any water storage reservoir to be impractically large and shallow. Thus the availability of water for urban areas is threatened during prolonged drought.

The 1997 flood was the most damaging. After the 1997 flood, efforts in the basin’s key urban areas to mitigate the impact of further floods included dikes, improved storm sewers and diversions. In the spring of 2006 these improvements were put to a test. The fourth largest flood in recent history occurred in the Red River Basin with minimal damage to major cities on the Red River (Wilkens, 2007).

Water management in the Red River Basin is guided by the federal water management policies of the United States and Canadian governments and the state and provincial policies of Minnesota, North Dakota and Manitoba. Within the United States portion of the basin there are two additional layers of local government organization dedicated to water and resource management. Soil and water conservation districts (SWCDs) in Minnesota and soil conservation districts in North Dakota are local units of government mandated to reduce soil erosion, protect water resources and support the adoption of best management practices to preserve resources. These districts have a slight name difference, but are fundamentally the same. These CDs are supported by the United States Department of Agriculture’s (USDA) Natural Resources Conservation Service with technical support and are generally housed in the local USDA building. Minnesota’s SWCDs are designated to produce county water plans. Both North Dakota and Minnesota CDs have the power to set a mill levy for the annual operation of the district.
Minnesota’s SWCDs have elected boards and are financially supported by the county governments and can impose special assessments, with county approval, to fund certain projects. North Dakota’s SCDs have appointed and elected boards. Both of these organization structures date back to the 1930s when the CDs where formed to address the resource issues of the dustbowl era (Hearne, 2007).

The principle institutions for local water resources management in North Dakota are the county-based WRDs. Water resource districts have evolved from drainage districts formed in the 19th century to clear agricultural land. Although traditionally involved with drainage, these districts have powerful legislative mandates that allow them broad powers to regulate water use, develop infrastructure and protect water resources. They are local units of government that coincide with county boundaries, with appointed boards that can utilize the power of eminent domain and are financed by a tax levy and special assessments allocated by county commissions (Hearne, 2007).

Minnesota has similar LWMDs, the WDs. These special purpose units of local government have been fostered by the state to manage and protect natural resources. Watershed districts are formed by local stakeholders to address local problems and follow natural hydrological boundaries. Currently, the entire Minnesota portion of the Red River Basin is covered by WDs. Watershed districts are partners with many other local and state entities in the planning and management of water needs (Board of Water and Soil Resources, undated). Watershed districts may impose an ad valorem tax levy of up to 1 mill (a tax of one thousandth of the value of a property) to fund organizational expenses, construction or implementation projects, or survey and data acquisition projects (Hearne, 2007; Minnesota Office of the Revisor Statutes, 2007).

A number of organizations seek to bridge jurisdictional boundaries to support collaboration between the basin’s stakeholders and governmental units. The International Joint Commission (IJC) is an official body of the United States and Canadian governments. The IJC’s International Red River Board allows local experts to make recommendations to these national governments on issues relating to Red River Basin management. A local organization, the Red River Basin Commission (RRBC) is a consortium of state, provincial and local constituencies. It provides a context where local stakeholders can address issues and seek cooperation across state and national borders to promote basin-wide goals. Among other services, the RRBC hosts a well-attended annual Red River Basin Conference. At this conference, many LWMDs meet state and federal agency officials, researchers and local authorities.

**Methods**

This study utilizes statistical analyses to assess the evolution of LWMDs through their adoption of certain initiatives and working arrangements as well as their general level of activity. Adoption studies are commonly used to assess the characteristics of economic agents, such as farmers, who adopt a new technology or management practice. A number adoption studies assume a discrete level of adoption and utilize probit or logit models (Chebil et al., 2007; Gedikoglu & McCann, 2007). If adoption is not discrete, a Poisson count model can be used to account for different levels of adoption (Ramirez & Shultz, 2000). Kim et al. (2005) point out that if the dependent variable is zero inflated, causing over dispersion, a negative binomial model is a good choice to assess adoption.

The set of LWMDs in the Red River Basin that are directed by a board of non-professional supervisors were selected for the analysis. This gives a total of 76 LWMDs in the survey population: 12 Minnesota WDs, 20 Minnesota SWCDs, 24 North Dakota WRDs and 20 North Dakota SCDs. Two survey
instruments were created, one for the administrative staff of each LWMD and one for the LWMDs’ 350 board members.

To assist in developing the survey instrument, over 30 interviews were conducted with a wide variety of local water management professionals and experts who helped create a majority of the survey questions. Subsequently, the large list of survey questions created from the interviews was reduced so the administrators of LWMDs could complete the survey instrument in less than one hour and board members in 15 min. To ensure the questions were not confusing to LWMD administrators, two trial surveys were conducted.

The administration of the survey instruments closely followed the Dillman Total Design Method (Dillman, 1978). Introductory postcards, survey instruments and reminder/thank you postcards were mailed in separate mailings in late 2006. The mailed survey instrument was accompanied by a letter of informed consent requesting voluntary responses and anonymity. In January 2007, e-mails and phone calls were made to organizations that had not responded. The board member’s survey followed the same procedure as the organization’s survey, except follow-up e-mails and phone calls were not made because response rates (181 of 350) were judged adequate to build the database. Data from the organization survey were merged with that of the board member survey. All responding organizations had at least one corresponding board member to complete these observations. When there was more than one responding board member from a LWMD, average responses from all responding board members were used. There tended to be little variation among the different respondents from the same board except for the years of board experience. Owing to a number of senior board members there tended to be a great variety in responses to this question.

A set of 22 dependent variables, representing activities, activity levels, or strategies, were chosen for analysis. These variables are listed in Table 1. Twenty-one of the 22 dependent variables demonstrate a number of positive activities including revenue generation, drainage, conservation, water quality, collaboration, recreation and research and development. One dependent variable, snagging and clearing, is generally considered an environmentally unfriendly activity, owing to increased water flows that degrade riparian shoreline and reduce chemical buffering.

Another set of 19 characteristics of LWMDs and LWMDs’ boards were chosen as potential explanatory variables. These explanatory characteristics are presented in Table 2. Some variables, such as the number of joint powers agreements that a LWMD was involved with were considered to be both dependent and explanatory variables.

Table 1. Dependent variables in analysis.

<table>
<thead>
<tr>
<th>Number of studies</th>
<th>Number of joint powers agreements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of recreation projects</td>
<td>Value of potable water supply projects</td>
</tr>
<tr>
<td>Value of wildlife habitat projects</td>
<td>Number of conservation contracts signed</td>
</tr>
<tr>
<td>Value of aquatic habitat projects</td>
<td>Hectares of windbreak/shelterbelt installed</td>
</tr>
<tr>
<td>Number of trees sold</td>
<td>Number of snagging and clearing efforts</td>
</tr>
<tr>
<td>Value of water quality projects</td>
<td>Kilometers of new or improved drainage ditch</td>
</tr>
<tr>
<td>Value of water movement projects</td>
<td>Dollars spent on contracting</td>
</tr>
<tr>
<td>Value of water retention projects</td>
<td>Kilometers of stream bank stabilization</td>
</tr>
<tr>
<td>Total grant funding</td>
<td>Level of ditch maintenance per year</td>
</tr>
<tr>
<td>Total revenue</td>
<td>Value of wetland restoration projects</td>
</tr>
<tr>
<td>Value of education projects</td>
<td>Number of organizations collaborated with on budgeted projects</td>
</tr>
</tbody>
</table>
A suggested statistical test to find characteristics of active LWMDs is multivariate analysis of variance (MANOVA) (Maxwell, 2001). A number of variations of MANOVA were attempted to complete the analysis. However, there were not enough observations and/or non-zero values to complete the MANOVA analysis. As an alternative to MANOVA, separate regressions were run on each of the 22 dependent variables using the 19 characteristics of LWMDs as independent variables. All possible models with the 19 independent variables were run using ordinary least squares (OLS), Poisson and negative binomial regressions.

Ordinary least squares regression analysis is well suited for continuous dependent variables with strictly positive values. A number of dependent variables have discrete yes/no data. Logit regressions are a good choice for this type of data (Kennedy, 1992). The logit model in its simplest form is:

$$\text{logit}(p_i) = \beta_1 + \beta_2 x_i,$$

where $p_i$ is the probability of success, $x_i$ is some quantity that influences the success or failure rate and $\beta_i$ are parameter estimates estimated by maximum likelihood (Dobson, 1983).

The dependent variable in a Poisson regression model follows a Poisson distribution which is skewed right and has no negative values. Therefore, Poisson regression models are adequate choices for count data where the dependent variable takes on a lot of small values and has a few larger values. In the Poisson count model, an integer-valued gradient is assumed to specify the level of adoption of the dependent variable. The Poisson Count Model can be expressed as:

$$E[Y_i] = \exp(\beta_1 X_{1i}) \exp(\beta_2 X_{2i}) \ldots \exp(\beta_k X_{ki})(i = 1, \ldots, n)$$

where $E[Y_i]$ is the expected value of the dependent variable for the $i$th observation, exp is the exponential function, $\beta_k$ are parameters associated with the $k$ independent variables and $X_i$ are the values of the $k$ independent variables in the $i$th observation and $n$ is the number of observations (Ramirez & Shultz, 2000).

In the Poisson regression, if the dependent variable’s mean does not equal the variance, over dispersion is likely to exist and a more appropriate model should be looked into (Kim et al., 2005). Negative binomial regression is a viable alternative, since the variance generally exceeds the mean in a negative binomial distribution (Kim et al., 2005). Negative binomial regression is an extension of the

### Table 2. Explanatory characteristics of WMOs and board members.

<table>
<thead>
<tr>
<th>CD</th>
<th>Number of other organizations board members are a part of</th>
</tr>
</thead>
<tbody>
<tr>
<td>In MN</td>
<td>Number of board members that have had cooperative extension training</td>
</tr>
<tr>
<td>Land area</td>
<td>Number of organizations collaborated with on budgeted projects</td>
</tr>
<tr>
<td>Population</td>
<td>Presence of state or federal agency employee on board</td>
</tr>
<tr>
<td>Downstream</td>
<td>Number of board members who attend water conferences</td>
</tr>
<tr>
<td>Number of meetings per year</td>
<td>Education/outreach staff hours per week</td>
</tr>
<tr>
<td>Board member experience</td>
<td>Administrative staff hours per week</td>
</tr>
<tr>
<td>Number of joint powers agreements</td>
<td>Technical staff hours per week</td>
</tr>
<tr>
<td>Percentage of board members who are farmers</td>
<td>District revenue</td>
</tr>
<tr>
<td>Percentage of appointed board members</td>
<td></td>
</tr>
</tbody>
</table>

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Poisson count models. Negative binomial regression follows a distribution where the variance is often larger than the mean. The negative binomial regression model can be expressed as:

$$\mu_i = \exp(a + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k)$$

where $\alpha$ is the intercept, $\mu_i$ is the log of the mean, $\beta_i$ are parameters and $X_i$ are the values of the $k$ independent variables.

The Akaike information criterion C (AICC) was used to select the best fit model among all possible combinations of explanatory variables and regression models. AICC is a measure of goodness of fit with a correction for small sample size. The model with the lowest AICC measure was selected. The more standard AIC measure is the foundation for AICC. The equations for AIC and AICC are as follows:

$$AIC = -2 \ln(L) + 2k$$

$$AICC = AIC + (2k(k + 1))/(n - k - 1)$$

where $L$ is the likelihood function and $k$ is the number of free parameters. When the OLS, Poisson, or negative binomial models did not produce results with significant explanatory characteristics, binary logit models were attempted (Hurvich & Tsai, 1989; SAS Institute Inc., 2006).

Results

Thirty-six of 75 organizations responded to the survey questionnaire. Potential respondents suggested that the end of the calendar year was an inconvenient time for this additional voluntary task. One hundred and eighty-one of the 350 board members returned completed surveys. It was necessary to compile publicly available financial data from some LWMDs that did not complete the financial section of the survey. The 50% response rate was considered to be acceptable. However a number of returned survey instruments had intermittent missing data which reduced the number of observations for a number of regressions.

Each best fit model, with the lowest AICC score, conformed to the prior judgment as to which distribution would present the best model for each dependent variable, based upon the distribution of the dependent variable. Four dependent variables did not yield usable regressions: (i) the value of wildlife habitat projects; (ii) the value of aquatic habitat projects; (iii) the value of potable water supply projects; and (iv) the level of ditch maintenance. The absence of usable regressions for the first three dependent variables was due to the LWMDs’ inactivity in these areas. There was not enough explanatory power in the independent variables to create a useful regression for the level of ditch maintenance. Dependent variables that yielded significant results are presented in Table 3. The detailed results of the regressions are presented in the Appendix (available online at: http://www.iwaponline.com/wp/145.pdf). The numbers of observations in these regressions vary. Some regressions used only data from CDs or WDs and WRDs because of the nature of the activities. Also, there were intermittent missing data in some observations.

Conservation districts were the focus of the first analysis of data derived from specific activities. Conservation districts’ traditional soil conservation mechanism was selling/planting trees for the
implementation of shelterbelts. They also encourage farmers to adopt no-till/no-tillage agriculture practices and to participate in government programs to reduce erosion. Since their inception, CDs have evolved to concern themselves with surface water quality issues and the traditional shelterbelt contracts have evolved into a variety of water quality conservation contracts. Regressions for activities specific to CDs were run using only observations from CDs.

All CDs participated in tree selling and the regression for the number of trees sold by CDs used OLS. Tree selling, the CDs’ most traditional activity, decreases as board member cooperative extension training increases. There is also a positive correlation between the number of trees sold and board member experience. It is possible that experienced board members continue to promote tree sales, while inexperienced board members and those with extension training focus their concerns on other areas.

Twenty of 22 responding CDs reported that shelterbelts were installed owing to their efforts. The hectares installed were widely distributed and a negative binomial distribution was used. Results illustrate a positive correlation between education/outreach staff and hectares of windbreaks/shelterbelts installed by CDs.

Table 3. Significant variables from 19 regression models.

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>Explanatory variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CD in MN Land area Population Downstream Percentage of board who are farmers Meetings per year Board member experience No. of joint powers agreements Organizations that board members are part of</td>
</tr>
<tr>
<td>Trees sold</td>
<td>++ -- -- -- -- -- --</td>
</tr>
<tr>
<td>Hectares of windbreaks</td>
<td>++</td>
</tr>
<tr>
<td>Conservation contracts signed</td>
<td>++ ++</td>
</tr>
<tr>
<td>For WDs and WRDs</td>
<td>New drainage ditch (km)</td>
</tr>
<tr>
<td>Water retention project value</td>
<td>-- -- -- -- --</td>
</tr>
<tr>
<td>Snagging &amp; clearing efforts</td>
<td>-- +++ -- --</td>
</tr>
<tr>
<td>Water movement project value</td>
<td>-- -- ++ --</td>
</tr>
<tr>
<td>For all WMAs</td>
<td>Stream bank stabilization (km)</td>
</tr>
<tr>
<td>Water quality project value</td>
<td></td>
</tr>
<tr>
<td>Wetland restoration value</td>
<td></td>
</tr>
<tr>
<td>Education project value</td>
<td></td>
</tr>
<tr>
<td>Recreation project value</td>
<td></td>
</tr>
<tr>
<td>Total studies</td>
<td></td>
</tr>
<tr>
<td>Data collection studies</td>
<td>-- -- -- ++</td>
</tr>
<tr>
<td>Engineering studies</td>
<td>-- ++ ++ ++</td>
</tr>
<tr>
<td>Water quality studies</td>
<td></td>
</tr>
<tr>
<td>Total revenue</td>
<td></td>
</tr>
<tr>
<td>Organizations collaborated with</td>
<td></td>
</tr>
<tr>
<td>Joint powers agreements</td>
<td></td>
</tr>
<tr>
<td>Total grant funding</td>
<td></td>
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</tbody>
</table>

(continued)
A number of North Dakota CDs did not sign any conservation contracts. Therefore, a Poisson regression was used. Board member attributes are shown to be important factors in the signing of conservation contracts. CDs with board members who are less experienced, who attend water management conferences and cooperative extension training, or who are federal or state employees are more likely to sign contracts.

Similar to CDs, WDs and WRDs have traditional activities they perform. These activities relate to water movement and water storage, principally drainage. Watershed districts and WRDs are responsible for drainage ditch permitting and have played a role in water retention. Snagging and clearing also is an activity specific to WDs and WRDs.

Two districts in both North Dakota and Minnesota did not approve any drainage ditch permits. Most districts approved less than 8 km of drainage ditch, three districts approved between 8 and 32 km of drainage ditch and one district approved over 32 km of drainage ditch. Therefore, the regression for

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>Table 3. (continued)</th>
<th>Explanatory variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees sold</td>
<td></td>
<td>Board members with extension training</td>
</tr>
<tr>
<td>Acres of windbreaks</td>
<td></td>
<td>District collaboration on budgeted project</td>
</tr>
<tr>
<td>Conservation contracts signed</td>
<td></td>
<td>Presence of agency employee on board</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Board members who attend water conference staff hours</td>
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<tr>
<td></td>
<td></td>
<td>Education/outreach staff hours</td>
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<tr>
<td></td>
<td></td>
<td>Administrative staff (hours/week)</td>
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<tr>
<td></td>
<td></td>
<td>Technical staff hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total staff hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>District revenue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Appointed board</td>
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</tbody>
</table>

### For CDs
- Trees sold (Tabulated value)
- Acres of windbreaks (Tabulated value)
- Conservation contracts signed (Tabulated value)

### For WDs and WRDs
- New drainage ditch (km) (Tabulated value)
- Water retention project value (Tabulated value)
- Snagging & clearing efforts (Tabulated value)
- Water movement project value (Tabulated value)

### For all WMAs
- Stream bank stabilization (km) (Tabulated value)
- Water quality project value (Tabulated value)
- Wetland restoration value (Tabulated value)
- Education project value (Tabulated value)
- Recreation project value (Tabulated value)
- Total studies (Tabulated value)
- Data collection studies (Tabulated value)
- Engineering studies (Tabulated value)
- Water quality studies (Tabulated value)
- Total revenue (Tabulated value)
- Organizations collaborated with (Tabulated value)
- Joint powers agreements (Tabulated value)
- Total grant funding (Tabulated value)

### Variables not included in regression
- + + + positive and significant variables at the 0.01, 0.05, and 0.10 significance level
- -- -- negative and significant variables at the 0.01, 0.05, and 0.10 significance level
kilometers of approved drainage ditch permit by WDs and WRDs used a Poisson distribution. There is a negative correlation between the number of joint powers agreements a district participates in and the kilometers of new or improved drainage ditch permitted by the district. Joint powers agreements show a concern for basin-wide goals, while drainage ditch passes the problem to downstream districts. This could explain the relationship between drainage ditch permitted and joint powers agreements. As expected, the influence of farmers on a district’s board increases the district’s attention to drainage.

A number of smaller districts did not spend money on water retention. Results of a Poisson regression illustrate a positive correlation between water retention projects and collaboration on budgeted projects. This positive relationship implies that collaboration does facilitate projects of the scale of water retention and perhaps that those districts involved with water retention are willing to cooperate with other impacted districts.

Five districts did not perform any snagging and clearing, eight districts performed one to three snagging and clearing efforts and two districts performed over three snagging and clearing efforts. Therefore, a Poisson regression was used for this analysis. Board member experience is positively correlated with the level of this traditional but perhaps environmentally unfriendly activity. Snagging and clearing decreasing as more board members attend water management conferences and with board members who are affiliated with other organizations. Water management conferences focus on basin-wide goals. A board member might become educated about snagging and clearings effect on flows and the degradation of the shoreline at water management conferences. Similarly, WDs and WRDs with greater collaboration through joint powers agreements are less involved with water movement projects.

Data relating to activities relevant to all three types of organization also were also analyzed. Because CDs, WDs and WRDs have evolved to be fairly homogeneous in their water quality practices, a number of water quality-dependent variables were assessed. As shown in Table 3, district collaboration on a budgeted project had a positive correlation with the value of water quality projects, the value of wetland restoration projects and the presence of recreation projects. Board member attendance at the RRBC conference was positively correlated with education and outreach projects and surprisingly negatively correlated with the value of water quality projects. Board member experience was negatively correlated with both the value of education and outreach projects as well as the presence of recreation projects.

Active LWMDs engage in a variety of studies for planning and assessment. Data collection is needed for water quality monitoring and to assess the feasibility and value of initiatives. Data for studies is listed in the number of studies as opposed to the dollar value of the studies. Board member cooperative extension training is negatively correlated with the total number of studies and data collection studies. The number of joint powers agreements is negatively correlated with the number of water quality studies and data collection studies. However, collaboration on budgeted projects is positively correlated with the number of engineering studies.

There are a number of institutional ways to work beyond traditional methods. For example, organizations can work together through collaborated projects to meet identical goals. Joint powers agreements also are used to come to an agreement on regional issues by a number of organizations and to agree upon methods used to complement each organization’s effort in response to regional issues. Contracting and securing grant funding are two other ways to work beyond traditional methods.

Total revenue is generally a function of the property taxes and special assessments that support a LWMD and its activities. However LWMDs can greatly supplement these funding sources with grants. Conservation districts obtain revenue through trees sales and services. Wealthier districts have more administrative and technical staff, more meetings.
Districts in Minnesota and those with larger populations were more likely to collaborate on budgeted projects. Districts in Minnesota had more joint powers agreements. Board member experience is negatively correlated with both the number of joint powers agreements and collaboration on budgeted projects. A better understanding of the characteristics of LWMDs that were more successful at gaining external grant funding was always an objective of this research. Only one characteristic has a significant impact upon grant funding. There is negative correlation with the number of board members that are affiliated with other organizations. The lack of explanatory power for total grant funding is disappointing. It is partially explained by the fact that only 15 districts reported grant funding in the last three years.

Discussion of pertinent characteristics

Conservation districts, WRDs and WDs have different specializations, but share a common interest in a number of activities. Conservation districts are housed in USDA buildings, along with Natural Resources Conservation Service (NRCS) and Farm Service Agency (FSA). Conservation districts receive NRCS and FSA support. This gives CDs a comparative advantage in the production of education/outreach and conservation contacts. For activities common to all LWMDs, this specialization was controlled by the use of a dummy variable to identify CDs. Conservation districts were shown to have less revenue and conducted fewer studies than the WRDs and WDs.

During the survey instrument development process, numerous experts stressed the importance of board members in the success of a LWMD. A number of board member attributes were discussed: (i) frequency of meetings; (ii) board member experience; (iii) board members having an active role in other forms of government; (iv) board member attendance at the annual Red River Basin water management conference; (v) board members who are farmers and (vi) board member education and training. The survey results confirm certain a priori expectations and reject others.

The number of board member meetings per year is perceived in two different ways. Some individuals feel that frequent meetings demonstrate a pro-active board that wants to accomplish a large number of goals. Others suggest that frequent board meetings reveal board members’ interest in receiving per diem payments. Results show that districts with greater revenue had more meetings. Given the absence of correlation between the number of meetings and 21 dependent variables, these results do not support a correlation between a pro-active and the number of board meetings.

Board member experience is correlated to a relatively large number of activities. Board experience has a positive relationship with a number of snagging and clearing efforts, which is considered to be a traditional duty of drainage districts that might have negative impacts on water quality and flooding. Board experience has a negative relationship with some other activities, some traditional and some non-traditional, including the dollar value of water retention projects, the number of conservation contracts signed by conservation districts, the number of collaborative budgeted projects, the number of joint powers agreements, the presence of recreation projects, the dollar value of education/outreach projects and the number of water quality studies.

Board members taking an active role in organizations outside their LWMDs were perceived to increase collaboration due to networking. Board members being part of the decision making body for other organizations has a positive relationship with the number of joint powers agreements entered into by an organization, the number of water quality studies and total LWMD revenue. A positive
relationship also exists between the kilometers of new or improved drainage ditch and total grant funding. A negative relationship exists with the number of snagging and clearing efforts.

The percentage of board members that attend water management conferences was expected to be an important determinate of collaboration and efforts to improve basin-wide water management. There is a negative correlation with between conference attendance and two traditional activities, snagging and clearing efforts, which tend to increase the velocity of water flows and exacerbate downstream flooding and tree sales. There also is a positive correlation between conference attendance and the number of conservation contracts signed by conservation districts, the value of education/outreach projects and the number of organizations collaborated with on budgeted projects.

Having a state or federal agency employee on a district’s board was thought to increase the availability of resources for the district. Resources are needed to entice landowners to give up potential farm revenue by signing a conservation contract. This notion is supported by the positive correlation between the presence of a state or federal agency employee and the number of contracts signed by conservation districts. There was an unanticipated correlation between this type of board member and total LWMD revenue.

District boards having a larger percentage of farmers were thought to be more concerned about drainage than water quality or wetland restoration. There was a positive correlation between the number of farmers on a board and the amount of new or improved drainage ditches and the number of joint powers agreements. Districts with farmers on the board had greater total revenue.

Previous to the study, board member training was thought to be an important characteristic of active LWMDs. In fact, board members’ cooperative extension training has a positive relationship with the number of conservation contracts signed, the kilometers of stream bank stabilization efforts and the number of joint powers agreements entered into by districts. There was an unanticipated negative correlation between cooperative extension training and studies.

Previously, studies and interviews with local water experts suggested that well-staffed LWMDs are more active than LWMDs with fewer staff (Draeger, 2001). Administrative staff hours are positively correlated with the number of conservation contracts signed by CDs, the kilometers of stream bank stabilization efforts and total revenue. The results unexpectedly identified a negative correlation between technical staff hours and stream bank stabilization and wetland restoration. In general these activities required outside contractors and the external staff dedicated to these activities may reduce the need for technical staff internal to the organization.

Water management organizations that take part in a larger number of joint powers agreements were thought to be more concerned about basin-wide problems. The number of joint powers agreements has a negative relationship with the kilometers of new or improved drainage ditch permitted, the value of water movement projects and data collection studies. This demonstrates that LWMDs that enter into more joint powers agreements are less concerned with traditional drainage and water movement activities.

Interviews revealed a consensus among water experts that districts in Minnesota are more active than those in North Dakota. Minnesota has more statewide water quality activity than North Dakota. However when a number of variables are considered the difference between North Dakota and Minnesota districts are not dramatic. Minnesota districts participate in more joint powers agreements and also conduct more studies.

Downstream districts, adjacent to the mainstream Red River, were expected to have different concerns owing to increased flood risk, more urban areas and greater land values. The difference between upstream and downstream districts is not dramatic. Downstream districts sell less trees and conduct fewer studies, ceteris paribus.
Conclusions and observations

Institutional evolution among LWMDs has occurred in the Red River Basin. This evolution can be shown in the creation of new institutional types, such as hydrologically defined watershed districts in Minnesota. It is also demonstrated by the adoption of new activities such as water quality projects, studies and streambank stabilization. New working arrangements such as grant seeking, joint powers agreements and collaborative projects have also been adopted.

This paper analyzes institutional evolution through the use of multiple adoption studies. Empirical analysis which assesses the characteristics that influence the adoption of new activities and the implementation of traditional activities does not demonstrate a dramatic difference between Minnesota districts and those in North Dakota, nor was a remarkable difference between upstream and downstream LWMDs demonstrated. These results do not conform to the a priori opinions of experts interviewed prior to the survey. Board member characteristics have significant influence on LWMD activities and institutional arrangements. Board member characteristics had more explanatory influence over adoption than staff characteristics. More experienced boards were less likely to adopt new activities and institutional arrangements.

There was consensus among experts interviewed that an increase in collaboration between WMOs in the Red River Basin is needed to accomplish basin-wide goals. This study shows that WMOs with larger education/outreach staff collaborate more. Furthermore, this study found that WMOs with experienced board members carry out less project collaboration.

Survey results demonstrate that few LWMDs carry out (i) wildlife habitat projects; (ii) aquatic habitat projects; or (iii) potable water supply projects. Adoption of new potable water supply projects may be constrained by the fact that rural populations are not increasing in the basin. Additional organizational evolution may be required before habitat restoration activities become common among current LWMDs. However the capacity of these organizations to evolve implies that new institutions may not be necessary to implement these functions.

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