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Groundwater Management in Nebraska: Governing the Commons Through Local Resource Districts

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ABSTRACT

In many areas of the Great Plains, a large share of the responsibility for establishing groundwater use and access controls rests with local resource districts. Many policy observers identify local inaction as a contributing cause to the rapid depletion of groundwater supplies in the region. Yet, the charge that local resource districts are incapable of effective resource management may be exaggerated. This paper describes a comprehensive groundwater control program established by Nebraska's Upper Republican Natural Resource District (URNRD). An analysis of the rule-making behavior of this district identifies a variety of factors which facilitated self-regulation.

INTRODUCTION

The depletion of the Ogallala aquifer has raised national awareness and concern about the vulnerability of groundwater supplies on the Great Plains.[1] Groundwater is being extracted much faster than the natural rate of recharge in many areas overlying the Ogallala—a situation typically referred to as groundwater mining.[2] While legal doctrines and regulatory authority over the groundwater resource vary between the states, Texas, Nebraska, Kansas and Colorado all rely in part on locally elected resource districts to manage the groundwater withdrawals and access.[3] In Texas and Nebraska local districts exercise almost sole authority to establish groundwater controls.

In the legal and policy literature from the Great Plains a large part of the blame for the excesses of groundwater mining has been placed with these local governing bodies. Local resource districts generally are depicted as staunchly resistant to even the most elementary management

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1. Erla Zwingle, *Wellspring of the High Plains*, NATIONAL GEOGRAPHIC, Mar. 1993, at 80.
2. J. David Aiken, *Ground Water Mining Law and Policy*, 53 U. COLO. L. REV. 505 (1982).
3. Rebecca S. Roberts, *Groundwater Management Institutions, in* GROUNDWATER EXPLOITATION IN THE HIGH PLAINS 88 (David E. Kromm & Stephen E. White eds., 1992).

forms. Keller, Heatwole and Weber state that "it may be difficult to mobilize popular support for regulatory policies, since district officials are more in agreement against regulation than the general population."[4] This resistance has been attributed to a number of factors including a highly individualistic ideology and an unwillingness to sacrifice current economic returns for the most basic conservation programs.[5] Nebraska's local resource districts (Natural Resource Districts or NRDs) have been described as "closed clubs of irrigators"[6] that are "destined to preserve the status quo while giving the appearance of movement toward the solution of pressing water problems."[7] Others suggest that professional and financial limitations effectively restrict the ability of Nebraska NRDs to effectively manage the groundwater resource.[8]

An independent line of research, however, has begun to focus on how local groups collectively manage shared resources. This diverse group of researchers including economists, anthropologists, political scientists and sociologists is undertaking more careful and detailed analysis of the self-regulating institutional systems devised by local groups to allocate important resources. Much of this literature has focused on the variety of ways in which local users have devised successful management schemes for shared resources.[9] Others have attempted to identify the factors which explain why some of the groups succeed and others fail to effectively manage these resources.[10]

Yet, few detailed studies exist in the policy literature concerning how and why local efforts at managing the High Plains' groundwater resource function and perform. Questions remain such as "How do they view the problems they face? What explains the choices that have been made? and What, if anything, have they accomplished?". Contrary to the characterization in the majority of the policy literature, the response of local resource districts to groundwater mining has been more varied and

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4. Lawrence F. Keller, et al., *Managing Crisis: The Effectiveness of Local Districts for Control of Groundwater Mining*, 17 WATER RESOURCES BULLETIN 647, 652 (1981).

5. Rebecca S. Roberts & Jacque Emel, *Uneven Development and the Tragedy of the Commons: Competing Images for Nature-Society Analysis*, 68 ECONOMIC GEOGRAPHY 249, 257 (1992).

6. Peter J. Longo & Robert D. Miewald, *Institutions in Water Policy: The Case of Nebraska*, 29 NAT. RESOURCE J. 751, 762 (1989).

7. *Id.* at 757.

8. ZACHARY A. SMITH, GROUNDWATER IN THE WEST 142 (1989); Longo & Miewald, *supra* note 6, at 756.

9. *See* THE QUESTION OF THE COMMONS: THE CULTURE OF ECOLOGY OF COMMUNAL RESOURCES (Bonnie J. McCay & James M. Acheson eds., 1987); *See also* MAKING THE COMMONS WORK: THEORY, PRACTICE, AND POLICY (Daniel W. Bromley ed., 1992).

10. Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (1990); Robert Wade, *The Management of the Common Property Resource: Collective Action as an Alternative to Privatization or State Regulation*, 11 CAMBRIDGE J. OF ECON. 95 (1987).

complex than simply a unified stand to protect the status quo.[11] This paper adds detail to this diversity by describing the groundwater management system designed and implemented by Nebraska's Upper Republican Natural Resource District (URNRD). The URNRD groundwater control program is one of the most comprehensive state or local efforts to manage the groundwater resource in the Ogallala region. An analysis of the URNRD rule-making behavior is provided that identifies the set of factors that contributed to the development of the URNRD's groundwater management system. It is hoped that a more complete understanding about the problems and successes of the URNRD will provide an incentive for a closer assessment of the future role that these local resource institutions will play in groundwater management.

LOCAL AUTHORITY TO MANAGE GROUNDWATER SUPPLY IN NEBRASKA

Prior to 1975, Nebraska groundwater law was governed almost exclusively by piecemeal judicial and legislative adjustments to the reasonable use doctrine.[12] A modification of the English absolute doctrine, reasonable use grants a nearly unlimited pumping privilege to all overlying landowners. Landowners are granted access to all water beneath their land and are entitled to pump as much water as can be put to beneficial or reasonable use on their overlying land.[13] When the Nebraska Supreme Court established the reasonable use doctrine in its first well interference case, the court also stated that in the event of insufficient groundwater supply, each user is entitled to a reasonable proportion of the whole groundwater supply.[14] The mixture of reasonable use and correlative rights[15] language created what is sometimes referred to the "Nebraska Rule of Reasonable Use."[16] Through 1975, this common law framework was only slightly modified by legislation.[17]

This legal structure was ill-prepared to manage the demands placed on the groundwater resource that came with the agricultural and

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11. Roberts, *supra* note 3.

12. J. David Aiken & Raymond J. Supalla, *Ground Water Mining and Western Water Rights Law: The Nebraska Experience*, 24 S.D. L. REV. 607, 618 (1979).

13. J. David Aiken, *Nebraska Groundwater Law and Administration*, 59 NEB. L. REV. 917, 923-24 (1980).

14. *Olson v. City of Wahoo*, 248 N.W. 304 (Neb. 1933).

15. Correlative rights, often called the California rule of correlative rights, represents an elaboration of reasonable use. Specifically, in times of shortage, the remaining supply can be divided between users on a proportional basis. *See* Aiken, *supra* note 13, at 926.

16. Smith, *supra* note 8, at 134.

17. Aiken, *supra* note 13, at 942-57.

irrigation boom of the 1970s. The advent of high-capacity pumps and efficient water delivery systems meant that the common law structure presented few effective limits on access to and use of the resource. In the event of groundwater mining, landowners did not have a secure claim to the water underlying their land since this common law framework did not define a user's rights to the resource with respect to others.[18] Without limits to access and use, users and the public were offered no protection against a mining situation and had little individual incentive to conserve water. A resource characterized by nearly unlimited rights to access and use has been labeled as an "open-access" situation.[19]

In response to rapid drops in groundwater levels in several regions of the state, the Nebraska Unicameral enacted the Ground Water Management Act (GWMA) in 1975.[20] This law granted primary responsibility for regulating groundwater with the local Natural Resource Districts (NRDs). A total of 23 NRDs blanket the state. Unlike other local resource districts in the region, Nebraska's NRDs are multi-purpose resource districts that are given a wide range of natural resource management responsibilities including soil and water conservation, flood and soil erosion control, drainage, rural water supply, recreation, forestry and range management, and wildlife habitat management.[21] The districts are governed by a locally elected board of directors and day-to-day operations are run by a manager and a full-time professional staff.

The GWMA established the NRDs as the central figure in state groundwater policy. The NRDs were granted the sole authority to alter rules governing use and access to groundwater in order to deal with groundwater mining. In order to exercise this authority, the state Department of Water Resources (DWR) must first approve an NRD request to create a groundwater "control area."[22] While the DWR determines whether a control area will be designated, the NRD is the only organization that may request a control area designation.[23] Thus, the decision to pursue groundwater regulation under the GWMA is left entirely with the NRD.

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18. Richard S. Harnsberger, et al., *Groundwater: From Windmill to Comprehensive Public Management*, 52 NEB. L. REV. 179, 205-6 (1973).

19. S. V. Ciriacy-Wantrup & Richard C. Bishop, *Common Property as a Concept in Natural Resource Policy*, 15 NAT. RESOURCES J. 713 (1975); Daniel W. Bromley, *Comment*, 21 J. OF ENVTL. ECON. AND MANAGEMENT 92 (1991); George D. Santopietro & Leonard A. Shabman, *Can Privatization Be Inefficient?: The Case of the Chesapeake Bay Oyster Fishery*, 26 JOURNAL OF ECON. ISSUES 407 (1992).

20. 1975 Neb. Laws, LB 577, NEB. REV. STAT. § 46-656 to 46-674 (1988).

21. NEB. REV. STAT. § 2-3229 (1991).

22. NEB. REV. STAT. § 46-658 (1988).

23. NEB. REV. STAT. § 46-658(1) (1988).

If the DWR approves the NRD request, the NRD may exercise a number of regulatory options within the control area. The GWMA grants the NRD Board of Directors the right to set access limits to the aquifer. The NRDs are granted authority to impose an annual well drilling moratorium.[24] The language in the GWMA, however, suggests that a moratorium should be considered as a last resort measure to manage a severe depletion problem. A complete ban on well drilling is considered constitutionally suspect under the Nebraska reasonable use doctrine since the "right of access is arguably a constitutionally vested right that cannot be taken away without payment of compensation."[25] In addition to the moratorium, the NRDs also are authorized to impose well-spacing requirements which are more restrictive than those required by state law.[26]

Within a control area, the GWMA provides the NRDs broad discretionary powers with which to regulate groundwater use. Specifically, systems of rotational pumping are authorized which place restrictions on when groundwater can be pumped.[27] The NRDs also may limit total withdrawals of groundwater by allocating how much groundwater can be pumped by different groundwater users.[28] An NRD may require the installation of water meters on wells in order to measure total well withdrawals.[29] In addition to these specific rules, the NRDs also may adopt other reasonable rules not specifically mentioned in the law but that are nonetheless deemed necessary to manage a groundwater depletion problem.[30] Implementation, monitoring, enforcement, and financing of these regulatory programs are also the responsibility of the NRD.[31] Thus, Nebraska groundwater policy is built squarely on the idea of local control.

UPPER REPUBLICAN NRD RULE-MAKING CONDUCT UNDER THE GWMA

This section describes the history and evolution of the groundwater policy in Nebraska's Upper Republican Natural Resource District (URNRD). The URNRD covers Chase, Dundy and Perkins

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24. NEB. REV. STAT. § 46-666(5) (1988).

25. NEBRASKA NATURAL RESOURCE COMMISSION, POLICY STUDY ON SELECTED WATER RIGHTS ISSUES 2-2 (1983).

26. NEB. REV. STAT. § 46-666(1)(c) (1988).

27. NEB. REV. STAT. § 46-666(1)(b) (1988).

28. NEB. REV. STAT. § 46-666(1)(a) (1988).

29. NEB. REV. STAT. § 46-666(1)(d) (1988).

30. NEB. REV. STAT. § 46-666(1)(e) (1988).

31. Aiken & Supalla, *supra* note 12.

counties in the far southwest corner of the state. This area has particularly important implications for future groundwater policy in Nebraska since this area has suffered the most severe declines in groundwater levels since the advent of pump irrigation.[32]

Like many other areas in Nebraska, the vast majority of all groundwater in the URNRD is pumped by irrigators. But unlike other areas, the southwest corner of the state experienced only minimal irrigation development up through the mid-1960s. The light soils of the region prevented the wide-spread use of the prevailing water delivery system existing at the time-flood irrigation.[33] The advent of the center-pivot system, however, rapidly changed agricultural practices in the area. In 1965 about 50,000 acres were irrigated in the three-county area.[34] In just 10 years the number of irrigated acres had increased to more than a quarter million.[35] Almost all of these new acres were irrigated with center-pivot systems.[36] The rate of irrigation development was further fueled by strong commodity prices in the early 1970s.[37]

By the early 1970s, water levels in irrigation wells across the district had begun to drop. In response, the URNRD funded a groundwater model study designed to explain groundwater levels and predict future changes in groundwater levels. The results of the groundwater model confirmed that the irrigation development was the cause of the declines. Furthermore, the model demonstrated the extent to which the aquifer was overdrawn. According to model projections, limiting access and cutting groundwater use in half would be insufficient to balance recharge with withdrawals.[38]

Faced with this situation, the URNRD requested that the DWR designate the district as a control area. In 1977 the Director of Water Resources approved the URNRD control area request.[39] After the control area designation, the URNRD became the first NRD in Nebraska to enact

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32. *See* NEBRASKA CONSERVATION AND SURVEY DIVISION, THE GROUNDWATER ATLAS OF NEBRASKA (1986).

33. Kurt Stephenson, Governing the Commons: History and Evaluation of Local Democratic Groundwater Management in the Nebraska Upper Republican Natural Resource District 109-111 (1994) (unpublished Ph.D dissertation, University of Nebraska (Lincoln)).

34. *Id.* at 131.

35. *Id.* at 131.

36. *Id.* at 122.

37. Gerold Dale McKenzie, Economic Factors that Affect Groundwater Irrigation Development in Nebraska (1988) (unpublished M.S. thesis, University of Nebraska (Lincoln)).

38. URNRD Groundwater Model Results, 1978-79.

39. The entire district however, was not designated as a control area. The small section of the district that lays south of the Republican River remained outside the control area because the aquifer is thin or absent in this area.

groundwater use and access restrictions under the GWMA.[40] The basic structure of these rules has remained in place since first being established in 1978.

Access Limitations: In order to effectively manage the rate of groundwater withdrawals, the URNRD Board realized that effective limits on access to the aquifer needed to be established. Although the URNRD Board considered imposing a well moratorium on several occasions, at that time the constitutional questions and well driller opposition realistically eliminated this option. Furthermore, many farmers in the area thought it would be unfair to deny the opportunity to irrigate to those individuals who did not cause the depletion problem.[41]

Given these limitations, the URNRD developed an alternative approach to limiting access to groundwater. Well-spacing requirements have been an accepted regulatory requirement in Nebraska since the late 1950s, but have been established primarily as a mechanism to prevent seasonal well interference rather than to limit access.[42] Under Nebraska state law, the well spacing requirement between irrigation wells is 600 feet.[43] In 1978, the URNRD imposed a 3,300 feet spacing requirement in certain areas within the control area.[44] Where applied, a 3,300 feet spacing requirement would sharply curtail new well drilling. This more restrictive well spacing requirement, however, was limited only to areas designated as "critical townships".[45] Using well measurement data, critical townships were identified by the annual rate of decline in the aquifer's saturated thickness.[46] In 1978, all townships where the annual decline in saturated thickness exceeded one percent were declared as critical. That year about a third of the district was classified under the critical township designation and thus subject to the more stringent well-spacing requirements. Such an approach ensured that groundwater depletion would not accelerate in the most critical areas, but, at the same time, this system allowed a pattern of development and depletion to occur before access was limited.

Over the next 15 years, new well drilling declined sharply for two reasons. First, high interest rates and low commodity prices during the 1980s sharply curtailed irrigation demand.[47] Second, when the farm economy began to recover in the early 1990s, the URNRD tightened the

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40. Aiken & Supalla, *supra* note 12, at 628.
41. URNRD public hearing transcripts, September 27, 1977.
42. Aiken, *supra* note 13, at 950.
43. NEB. REV. STAT. § 46-651 to 46-655 (Reissue 1988).
44. URNRD Rules and Regulations for Groundwater Control, Order 1, Rule 5 (1978).
45. *Id.* A township is a six mile square tract of land.
46. *Id.* at Rule 1 (d).
47. Stephenson, *supra* note 33, at 289.

rules governing aquifer access. In 1991, the critical township criteria was tightened to an annual decline in saturated thickness of one-half of one percent.[48] The following year the critical township was again reduced to one-fourth of one percent.[49] Each action significantly expanded the area subject to the more stringent well-spacing requirements. Furthermore, well-spacing requirements in critical townships were extended from 3,300 feet to one mile in 1992.[50] The combination of the more restrictive critical township criteria and well-spacing requirements effectively eliminated new well drilling in about 85 percent of the control area.

Recently, high commodity prices placed increased pressure to drill new irrigation wells on land still not designated as critical. Furthermore, above average rainfall temporarily slowed the decline in water tables, threatening to significantly reduce the amount of land covered under the critical township designation. The combination of these two factors threatened to undermine the system to limit access. In response, the URNRD approved a well drilling moratorium over the entire control area in February 1997.[51] This is the first well moratorium ever to be imposed in Nebraska.

Use Limitations: To manage the groundwater withdrawals from established wells, the URNRD implemented a system to allocate groundwater among individual users. In 1978 the URNRD required each high-capacity well in the district to be equipped with an approved flow meter by April 1980.[52] This was the first area on the Great Plains that required well meters on all irrigation wells.[53]

The URNRD also established quantitative limitations on groundwater withdrawals.[54] The total volume of water that a well operator is permitted to withdraw is assigned to each well. Groundwater use per well is based on the total amount of water that can be applied on each acre irrigated by the well. Thus, a 15 inch allocation grants the well operator the equivalent amount of water to cover each irrigated acre assigned to that well in 15 acre inches of water in a given year.[55] To grant flexibility in individual water management, the per-acre allocation is summed over a five year period and is referred to as a five year

48. URNRD Rules and Regulations for Groundwater Control, Order 14, Rule 7, (1991).

49. URNRD Rules and Regulations for Groundwater Control, Order 15, Rule 7, (1992).

50. *Id.*

51. URNRD Rules and Regulations for Groundwater Control, Order 20, Rule 16, (1997).

52. URNRD Rules and Regulations for Groundwater Control, Order 1, Rule 3 (b), (1978).

53. Roberts, *supra* note 3, at 94-95.

54. URNRD Rules and Regulations for Groundwater Control, Order 1, Rule 3, (1977); Order 3, Rule 4 (1980); Order 6, Rule 4, (1983); Order 11, Rule 5, (1988); Order 16, Rule 5 (1993).

55. An acre-inch is approximately 27,000 gallons.

allocation period. Thus, a 15 inch annual allocation grants a irrigator the right to pump a maximum of 75 inches per acre over five years. There are no restrictions on when or how the 75 inches is allocated through the five year allocation period.

After a trial allocation period (1980-82), the first five year allocation (1983-1987) was set at 80 inches per acre for acres irrigated with center-pivots (16 inches per year).[56] The following two allocation periods were marked by a gradual tightening of the allowable water use. The 1988-1992 and 1993-97 allocations established five year allocations of 75 inches per acre (15 inch annual allocation) and 72.5 inch per acre (14.5 inch annual allocation) respectively.[57] These five-year allocations were not established to achieve a specified aquifer life goal or a specified target rate of decline in the aquifer's saturated thickness. Instead, allocations were set so that a farmer using sound water management practices could continuously grow corn. In adopting allocations, the URNRD board sought to avoid undermining irrigator support for the rules. Yet, the annual water use rates reflected by the allocations were not so generous as to be nonbinding. When allocations were set, typically about 15 to 25 percent of all wells pumped more water in the previous allocation period than was allowed by the new allocation level.[58] For example, when the 1988-1992 allocation was being considered, 19.8 percent of all irrigation systems exceeded an annual average application rate of 15 inches per acre between 1983 and 1987.[59] Thus, URNRD groundwater use rules act as a way to reduce a free-rider problem-inducing technically inefficient groundwater users to adopt better water management practices.

To allow flexibility into the allocation system, the URNRD also provides irrigators with options on how to meet the withdrawal limits through "carry-forward" and "pooling" provisions. These rules are similar to the bubble, netting and banking provisions in the national air pollution control program. To encourage irrigators to reduce water use below the allocation, the well operator is allowed to bank or "carry-forward" unused water from one allocation period to the next.[60] Pooling allows the irrigation well operator to combine allocations from different wells as so long as the combined allocation does not exceed the sum of

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56. URNRD Rules and Regulations for Groundwater Control, Order 6, Rule 4, (1983). To allow more water intensive gravity flow irrigators an opportunity to adjust to the new rules, the 1983-87 allocation permitted the withdrawal of up to one hundred inches per acre for wells irrigating through gravity flow distribution systems (22 inch annual allocation).

57. URNRD Rules and Regulations for Groundwater Control, Order 11, Rule 5, (1988) and Order 16, Rule 5 (1993).

58. Stephenson, *supra* note 33, at 233, 248.

59. *Id.* at 248.

60. Carry-forward provisions were initially established under URNRD Rules and Regulations for Groundwater Control, Order 1, Rule 3 (3)(b) (1978).

the individual wells.[61] Thus, pooling arrangements permit a well operator to apply 10 inches per acre on a field with clay soil and 20 inches per acre on a field with sandy soil and still meet a 15 inch annual allocation.

Outcomes of the URNRD Regulatory Program: The impact of the URNRD groundwater management program on aquifer withdrawals is difficult to determine since pumping data does not exist prior to the well monitoring/regulatory period. Yet, there are secondary indicators that may give an indication of the changes in water use patterns both before and after the implementation of groundwater controls. In the URNRD, stream flow in the Frenchman Creek serves as an indicator for two reasons. First, the Frenchman Creek stream flow is almost derived primarily from groundwater discharge.[62] Second, the headwaters of the Frenchman Creek are located within Chase County so any changes in stream flow can be attributed primarily to county-level changes in aquifer levels.

Figure 1 shows Frenchman Creek stream flows from 1949 through 1992. Stream flow is divided into three time periods. The 1949-1967 period corresponds to the period prior to the widespread introduction of the center-pivot. The 1968-1979 period corresponds to the period of center-pivot irrigation and unregulated withdrawals, while 1980-1992 covers the regulatory period. Accounting for these periods and for variations in total precipitation, stream flow declined by an average annual rate of 141 CFS-Days between 1949 and 1967.[63] During the middle period, the decline in stream flow accelerated sharply. Between 1968 and 1979, the rate of decline averaged 1,069 CFS-Days each year.[64] During the regulatory period, however, the decline in stream flow was significantly curtailed to an average annual decline of 349 CFS-Days.[65] This finding lends support for the conclusion that the URNRD groundwater control rules had a significant impact in altering the rate of groundwater withdrawals.

PROSPECTS FOR LOCAL DEMOCRATIC RESOURCE MANAGEMENT

The experience in the URNRD calls into question many general assumptions concerning the willingness and ability of locally elected resource management districts to effectively manage groundwater. In

61. Pooling provisions were initially established under URNRD Rules and Regulations for Groundwater Control, Order 1, Rule 2 (d) (1978).

62. Eric G. Lappala, Quantitative Hydrogeology of the Upper Republican Natural Resource District (1977) (unpublished M.S. thesis, University of Nebraska-(Lincoln)).

63. Stephenson, *supra* note 33, at 313-19.

64. *Id.* at 316.

65. *Id.*

Nebraska, the URNRD has designed, implemented, and enforced one of the most aggressive groundwater management systems anywhere on the Ogallala aquifer. The obvious question stemming from this experience is why did this local group supply themselves with a new set of groundwater use and access rules-especially given the characterization of other local efforts? The answer to this question holds important implications for the development and promotion of similar self-regulating resource management systems.

An explanation to this question for the URNRD can be framed within the metaphor of the demand and supply of institutional change.[66] The demand for a new set of institutional arrangements comes from recognizing the net benefits of imposing constraints on use and access rules over a resource. The supply of institutional change stems largely from a willingness and ability to provide a new set of rules governing resource use.

While this paper is concerned with the rule-making behavior of the URNRD and thus the "supply side" change, the role of the demand side issues provides important insights into the groundwater rule changes of the URNRD. For the farmers in the semi-arid west, the benefits of irrigation are obvious-irrigation provides lower yield risk, without increasing the cost to produce a bushel of corn. In the URNRD, a clear, not-too-distant threat to these future benefits quickly developed during a period of optimism in the agricultural sector. Furthermore, irrigation benefits were not confined to farm operators. Due to the historical changes in agriculture, the communities in southwest Nebraska have been experiencing gradual economic deterioration. From the 1930s through the 1960s, the three counties that comprise the URNRD were steadily losing population.[67] While other parts of the state were benefiting from irrigated agriculture since the 1940s, the future of many of these communities was in jeopardy.

The advent of the center-pivot, however, profoundly changed the outlook of the community. During the 1970s, the population in the three-county area increased for the first time since the Great Depression.[68] The six-fold increase in corn production that occurred between 1965 and 1975 spurred the rapid new agribusiness growth. In the 1970s, retail sales growth increased at a rate well above the state average.[69] Thus, the benefits of irrigation driven growth was clear and unambiguous not only to the farm operators, but also to the community.[70]

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66. DAVID FEENY, THE DEMAND FOR AND SUPPLY OF INSTITUTIONAL ARRANGEMENTS, IN RETHINKING INSTITUTIONAL ANALYSIS AND DEVELOPMENT: ISSUES, ALTERNATIVES, AND CHOICES 159 (Vincent Ostrom, et al. eds., 1988).

67. Stephenson, *supra* note 33, at 103-04.

68. *Id.* at 134.

69. *Id.* at 133-34.

70. *Id.* at 134-38.

Yet, an impetus for change does not always translate into effective institutional change. Other local districts on the Great Plains may have faced similar demands, but have failed to alter the basic structure of rules leading to the problem. The water policy literature from the Great Plains charges these local resource districts with inaction, but often neglects to provide a comprehensive explanation as to why they have failed. In many cases an inability to act may be wrongly interpreted as an unwillingness.

A number of factors can be identified that explain the implementation of the groundwater management program in the URNRD. The factors that contributed to the URNRD groundwater rules can be grouped into two general types: (1) situational factors or contingencies and (2) policy factors. Situational factors are conditions that appear to have contributed to the development of new groundwater rules that may be spatially or temporally unique to the URNRD. Policy factors, on the other hand, are discretionary policies that contribute to groundwater rule development. The specific explanations identified in the URNRD are summarized in Table 1. Such a framework can help identify which factors facilitate effective management.

SITUATIONAL FACTORS

Any pattern of natural resource use, and attempts to govern that use, are partly a result of a unique confluence of different, and often independent, historical developments. Historical contingencies obviously imply a temporal dimension. Leonard Shabman states "choices are made in response to opportunities and constraints understood to be effective at the moment a decision is made."[71] In the URNRD, such a set of opportunities facilitated the development of its groundwater management system.

Rapid groundwater development occurred later in the URNRD than it did in many other areas of the Great Plains. When the irrigation boom ignited in the URNRD in the late 1960s, the understanding of how the hydrologic system functioned had reached a mature state of development. Thus, estimating the water flow through the hydrologic system was possible. As a contrast, in the Texas panhandle region irrigation development occurred earlier when the science was in its infancy. The development of groundwater management systems in the 1950s in Texas could not be based on sound hydrologic cause and effect relationships.[72]

Another temporal dimension of groundwater rule-making surrounds the historical relationship between the surface water irrigation

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71. Leonard A. Shabman, *Water Resources Management: Policy Economics for an Era of Transitions*, 16 SOUTHERN J. OF AGRICULTURAL ECONOMICS 53, 54 (1984).

72. *See* DONALD E. GREEN, LAND OF THE UNDERGROUND RAIN (1973).

project and the URNRD groundwater development. The possible depletion of groundwater resources has been viewed historically by irrigators as a justification for the construction of surface water diversion projects.[73] The possibility of constructing a water diversion project (water rescue project) meant groundwater regulations could be postponed in lieu of importing supplemental surface water.[74] The groundwater mining problem in the URNRD developed in the transition period of water resources development. The rise of the environmental movement in the 1960s forever changed the way these irrigation projects were viewed and evaluated.[75] Importing surface water when groundwater supplies were being depleted was never an immediate possibility in the URNRD. Unlike other regions in Nebraska, the URNRD was never a serious candidate for such a project. Furthermore, farmers in Perkins, Chase, and Dundy counties had almost no experience with surface water irrigation.

In addition to these temporal dimensions, the dynamics of local conflicts over water use contributed to the development of the URNRD groundwater rules. In the URNRD, the dominant use of water is irrigated agriculture, and therefore the URNRD did not find itself in the middle of a water war between competing types of users. In addition, industrial structure may be an important factor in local ability to manage a resource. Agricultural assets in the URNRD are still predominantly held by local farmers, but a smaller (but significant) amount of irrigated land is controlled by limited partnership and corporate farms.[76] In the URNRD, representatives and farm managers of absentee owners have demonstrated a consistent opposition to the more stringent groundwater allocations.[77] If the interests of the local community diverge significantly from those controlling the productive assets, the community may not be able to effectively manage the resource.[78]

The different response to the groundwater rules within the agricultural community also should focus attention to the belief systems of the regulated groups. Often the farmers are portrayed as holding a belief system too individualistic to impose a groundwater control program. Throughout the history of the URNRD, its directors have almost exclusively been made up of irrigators. While exhibiting a strong respect for individualism and private property rights, the belief systems of the

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73. Aiken, *supra* note 2, at 518.

74. *Id.* at 518-28.

75. J. David Aiken, *New Directions in Nebraska Water Policy*, 66 NEB. L. REV. 22-50 (1987).

76. Burt Evans et al., *Wheels of Fortune* (Center for Rural Affairs, Jan. 1976).

77. Stephenson, *supra* note 33 at 337-38.

78. David Todd, *Common Resources, Private Rights and Liabilities: A Case Study of Texas Groundwater Law*, 32 NAT. RESOURCES J. 233, 259-60 (1992). Todd suggests that a similar problem exists in Texas.

irrigators in this area provided justification and support for the self imposition of groundwater regulations. In general, their belief system reflects a strong conservation ethic and faith in the efficacy of science and technology to provide solutions to problems. The URNRD directors do not consider it an undue restriction on individual liberty to impose groundwater withdrawal limits as long as those limits are achievable using readily available technology and reasonable management practices. Directors typically argue for further reductions in groundwater allocations based on demonstrated advances in technology that decrease per-acre irrigation requirements.

The notion of limited government is also identified with an individualistic ideology. Yet, the local nature of the decision process has helped alter the pejorative view of "government regulation." Although the URNRD is an official state-created organization, its board does not consider its own groundwater regulations government interference. Since all rules are approved and enforced by irrigators—with the support of the majority of local farmers—the directors view their rule-making activities as different than what the "government" does. In short, farmers are not a homogeneous group and it would be a mistake a blame failure to control groundwater use on a particular ideology without careful analysis.

POLICY FACTORS

In addition to the situational factors, there also exists a set of policy factors that help explain the emergence of groundwater rules in the URNRD. State laws are a group of factors that impact the willingness and ability of local districts to design and implement an effective set of groundwater rules. Local groundwater management organizations must operate under these laws that define the authority of the district to alter groundwater use and access rules. This set of rules, labeled as collective choice rules, defines what the district may or may not, can or cannot do to alter use and access to the resource.[79] The set of collective choice rules can be delineated into five groups: boundary, financing, regulatory, decision, and enforcement rules. This overlying legal structure varies within the Ogallala region. It is argued here that the collective choice rules in the URNRD facilitated the development of its groundwater management system.

Boundary Rules: All local districts operate within specified jurisdictional boundaries. Boundary rules define the legal domain of local rule-making organizations. If legal boundaries do not closely coincide with

79. Ronald J. Oakerson, *Analyzing the Commons: A Framework, in* MAKING THE COMMONS WORK: THEORY, PRACTICE, AND POLICY 41 (Daniel W. Bromley ed., 1992); Ostrom, *supra* note 10.

the physical boundaries of the resource, effective management may be difficult. For instance, some policy observers have suggested local district boundaries in Texas may be too small to adequately control groundwater levels in their areas.[80]

Control area boundaries in the URNRD roughly coincide with geographical and topographical boundaries. The aquifer is confined to the north and south by the Platte River and Republican River respectively.[81] Irrigation development to the east is limited to a large extent by dissected plains typography. Only Colorado groundwater withdrawals on the western border impact groundwater levels in the URNRD. While declines in aquifer levels are typically more severe along the Chase and Dundy borders with Colorado, the additional drawdowns are limited in scope to only a few miles. Thus, there exists an incentive to design a groundwater control program since the URNRD is able to capture most of the benefits of such a program.

Decision Rules: Several features of the decision-making process also aided URNRD rule development. Decision rules define how changes in regulatory rules are made. In the URNRD use and access rules are proposed and finalized by eleven directors.[82] Research tends to support that a limited number of participants facilitates decision-making.[83] Furthermore, the open and participatory process of rule-making in the URNRD tends to build trust and diffuse opposition among irrigators. The URNRD makes concerted efforts through promotions of information meetings and public hearings to involve and inform the public in the rule-making process. Although certainly a function of circumstances existing in the area, the decision-making process contributes to a very high rate of public discussion and participation.[84]

Regulatory Rules: Regulatory rules are grants of authority to impose use and access rules. In the GWMA these grants of authority are clearly laid out for the NRDs. The GWMA explicitly authorizes the use of well-spacing and restrictions on use. As a result, the costs and uncertainty of creating and implementing a set of rules are minimized. Yet, the language of the GWMA is broad enough to allow local districts flexibility in the design of use and access rules.

Monitoring and Enforcement: Under the GWMA, the NRDs also are given explicit authority to enforce regulatory rules.[85] Enforcement and

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80. Todd, *supra* note 78, at 259.

81. Lappala, *supra* note 62.

82. The total number of directors in the URNRD is modest compared to NRDs with more than twenty members.

83. Ostrom, *supra* note 10, at 198-202.

84. Stephenson, *supra* note 33, at 186-275.

85. NEB. REV. STAT. § 46-663 (1988).

monitoring rules define what actions local groups are authorized to undertake in enforcing and monitoring groundwater use and access rules. The URNRD has shown little reluctance to exercise this authority. Throughout the history of the groundwater program, the URNRD has rarely granted well drilling variances and has issued cease and desist pumping orders to irrigators who exceeded their groundwater allocations.[86]

Financing Rules: Finally, financing rules are required to define how the local rule-making body generates revenue and who will incur the costs of collective management. In Texas, the financial limits of local resource districts have been suggested as a potential barrier to the development of local groundwater regulations.[87] Although the URNRD relies on a property tax to finance its activities, the overall tax burden is modest. The tax base generates sufficient revenue to finance the design, monitoring, and enforcement of the groundwater program. Furthermore, the multi-purpose nature of the NRDs enable the URNRD to realize a certain amount of scale economies from the consolidation of many related administrative and natural resource functions.

CONCLUSIONS

Too often in the natural resource and policy literature, alternative institutional arrangements are reduced to either/or scenarios. Vesting a state agency with groundwater rule-making authority is often argued to be superior to granting local organizations regulatory control.[88] Privatization is argued to be a superior solution to social discretionary control.[89] Yet, groundwater allocation systems, like the modern economy itself, will contain elements of all three.

Given its localized nature, groundwater is a resource with the physical properties that lends itself to the possibility of some degree of local control. The experience in the URNRD calls for a reconsideration of the role of local self-regulation in managing the water of the Ogallala aquifer. The groundwater control program developed in the URNRD is one of the most comprehensive of any local or state programs on the Great Plains. The experience in the Upper Republican NRD should provide an incentive to direct more attention to the set of conditions which allow and encourage local design of resource management systems, rather than simply dismissing the local option.

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86. Stephenson, *supra* note 33, at 254-260.

87. Todd, *supra* note 78, at 262.

88. Keller, et al., *supra* note 4, at 654.

89. TERRY L. ANDERSON, et al., Privatizing Groundwater Basins: A Model and Its Application, in Water Rights: Scarce Resource Allocation, Bureaucracy, and the Environment 223 (Terry L. Anderson ed., 1983).

Figure 1: Frenchman Creek Stream Flow, 1949-1992 (measured near Imperial Nebraska)

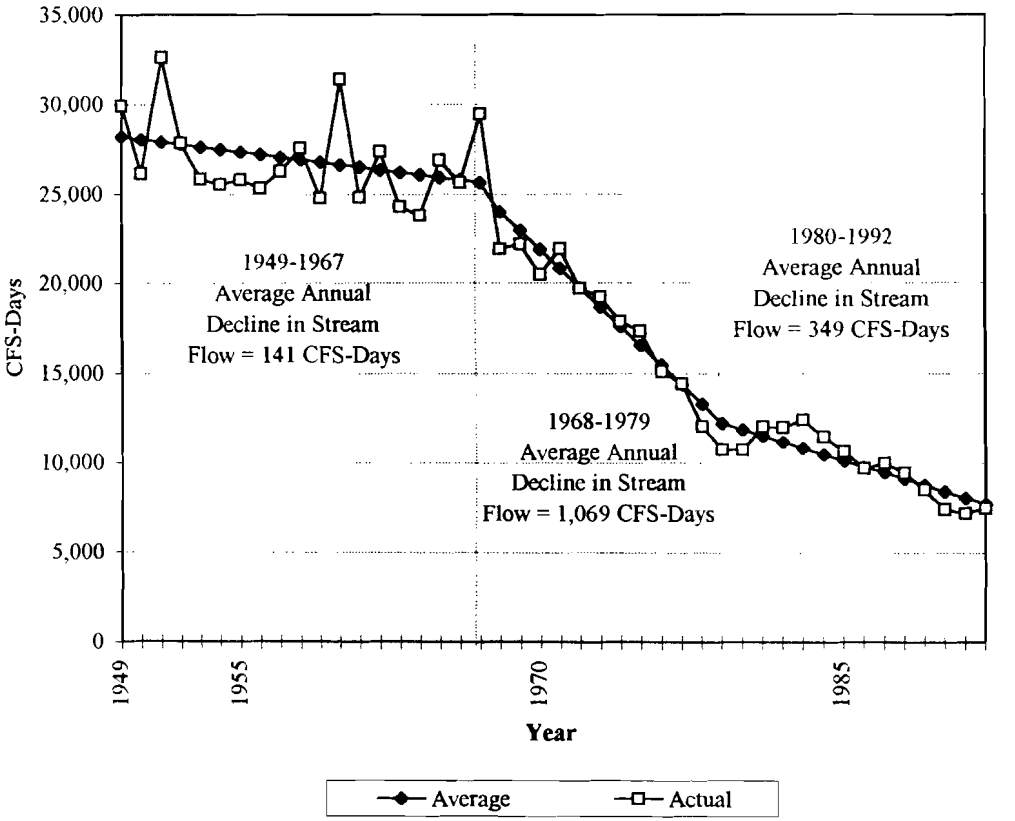

Table 1: The Supply of New Local Groundwater Rules in the URNRD

SITUATIONAL FACTORS (CONTINGENCIES):

Substitute Water Sources

Existing Knowledge Base

Belief Systems

Dynamics of Conflict

POLICY FACTORS:

Boundary Rules

Decision Rules

Regulatory Rules

Financing Rules

Monitoring/Enforcement