
NATURAL RESOURCES JOURNAL

Volume 35
Issue 2 *Spring 1995*

Spring 1995

Local Groundwater Management Effectiveness in the Colorado and Kansas Ogallala Region

Stephen E. White

David E. Kromm

STEPHEN E. WHITE and DAVID E. KROMM*

Local Groundwater Management Effectiveness in the Colorado and Kansas Ogallala Region

ABSTRACT

Groundwater management districts were formed more than two decades ago throughout the High Plains of Colorado and Kansas to oversee the orderly expansion of irrigation in the region. This study examines the attitudes of 330 irrigators concerning the effectiveness of these districts. The districts in Kansas possess greater power than those in Colorado, but both have important responsibility for the High Plains Aquifer in a time of conflict over water use and concern for groundwater depletion. Innovative programs have been introduced in several districts. Most continue to have the confidence of relevant state agencies and the support of the irrigators they serve with respect to policies and objectives.

Irrigators throughout the Kansas and Colorado Ogallala region share a common perspective on district weaknesses and levels of acceptance for broad management objectives. However, considerable differences of opinion occur for specific management options. Also, a substantial minority (40 percent of all irrigators) are undecided about whether or not their own district represents their personal self interest. The diversity of thought presents groundwater managers a challenging task convincing irrigators to accept a mutually agreed upon, local management strategy.

INTRODUCTION

The institutional structure of water management in the western United States is under intense pressure because of competing demands for water. Water supply systems and sources developed primarily for agriculture are now being asked to serve urban, recreational, and environmental needs. Sometimes the institutions themselves, the pattern of agencies, laws, and policies impede flexible use of water as they protect the stakeholders for which they were crafted.[1] In response, there

---

* Stephen E. White is Professor and Head of the Department of Geography at Kansas State University. He has written widely on groundwater depletion issues in the High Plains, internal migration in the United States, and return migration to Central Appalachia. David

exists a devolution of water management from the federal (such as the U.S. Bureau of Reclamation) to the state, and from the state to local entities. Decentralization of power and decision-making challenges the long-prevalent top-down approach to water management.[2] Groundwater management districts in the High Plains provide examples of institutions formed largely to serve irrigation interests, but that also seek local autonomy. In this paper we evaluate groundwater management districts in Colorado and Kansas. Are the districts relics of a single-purpose past unsuited to the multiple-demand present, or have they evolved into a model of the new representative and adaptive local organizations touted as the future wave?

Susan Nunn's argument for local control is very pragmatic. ". . . pump irrigators will not support an alternative rule designed to increase security of future water availability if it strips the land owner of discretion and authority that is valued more highly than the future security."[3] Likewise, Jean Williams notes that while irrigators will not voluntarily conduct a local water management program, "without the active concurrence and support of water users involved, and [their] full recognition of the problems to be solved and the benefits gained by submitting to a management strategy, it is unlikely that imposition of management would be politically or practically feasible."[4] The academic assertion that local groundwater management is a conceptually appropriate response for good management is also supported by the realization that success depends on the irrigators who have the power to make water-saving decisions, the expertise to help shape and encourage innovative management programs, and the self-interest to gain from successful water saving strategies.

The notion of local involvement in water management enjoys support among scholars viewing the phenomenon through varied lenses. David Freeman, a sociologist, believes that local water management brings a necessary particularizing mode of knowledge to bear on

---

E. Kromm is Professor of Geography at Kansas State University. He has written extensively on water management issues in the United States, Canada and the United Kingdom.

1. *JOHN FERNIE & ALAN S. PITKETHLY, RESOURCES: ENVIRONMENT AND POLICY (1985).

2. ARTHUR MAASS & RAYMOND L. ANDERSON, . . . AND THEY SHALL REJOICE: CONFLICT, GROWTH, AND JUSTICE IN ARID ENVIRONMENTS, (1978); Morag Bell, *The Water Decade Valedictory, New Delhi 1990: Where Pre- and Post- Modernism Met*, 24 Area, 82 (1992).

3. Susan C. Nunn, *The Political Economy of Institutional Change: A Distribution Criterion for Acceptance of Groundwater Rules*, 25 Nat. Resources J. 867, 877 (1985).

4. Jean Williams, *Some Challenges and Opportunities in Groundwater Management*, 1984 ANNUAL CONFERENCE PROCEEDINGS: GROUNDWATER MANAGEMENT DISTRICTS ASSOCIATION 3.

decision-making instead of relying only on abstract professional principles and remote bureaucracies. He notes that "local people possess extensive idiographic knowledge, built through long experience and encoded tradition and custom".[5] Frances F. Korten, a social psychologist, and Robert Siy, a planner-economist, advocate institutions that empower local people to take an active role in the implementation of governmental water programs.[6] Warren Viessman, a civil engineer, calls for local authorities with broad powers, along the lines of Florida Water Management Districts and the Nebraska Natural Resource Districts.[7] The geographer Morag Bell argues that the devolution of power to more local authority may be "interpreted as a positive attempt to challenge the uniformity of modernity".[8]

STATEMENT OF PURPOSE

Since the 1950s there has been widespread concern that water was being wasted and ill-used in many areas of intensive groundwater use. However, ". . . concern was not translated into effective institutional change".[9] In the High Plains Ogallala region, four states (Colorado, Kansas, Nebraska, and Texas) have attempted to take a local decision-making approach to groundwater management in order to cope with groundwater depletion.[10] These institutions were organized during an era of irrigation expansion when the major focus was controlling groundwater appropriation according to a policy of planned depletion. Now that many areas are fully appropriated, the emphasis has shifted to that of minimizing water use and improving water-use efficiency. Can local groundwater management districts adjust to the conservation era and away from the appropriation era? Gardner believes that ". . . water institutions which may have served the region so well during its development phase no longer appear to be adequate now that competition for water is severe".[11] This study examines three broad questions related to the evolution of groundwater management institutions at the

5. DAVID M. FREEMAN, LOCAL ORGANIZATIONS FOR SOCIAL DEVELOPMENT 15 (1989).

6. FRANCES F. KORTEN & ROBERT Y. SIY JR., TRANSFORMING A BUREAUCRACY: THE EXPERIENCE OF THE PHILIPPINE NATIONAL IRRIGATION ADMINISTRATION (1989).

7. Warren Viessman, Jr., *A Framework for Reshaping Water Management*, 32 Env't 32 (1990).

8. Bell, *supra* note 1.

9. Nunn, *supra* note 2 at 871.

10. David E. Kromm & Stephen E. White, *Interstate Groundwater Management Preference Differences: The Ogallala Region*, 86 J. of Geog. 5 (1987).

11. B. Delworth Gardner, *Institutional Impediments to Efficient Water Allocation*, 5 Pol'y Stud. Rev. 353, 354 (1985).

local level. In examining these questions, this study provides a comprehensive evaluation of districts in Colorado and Kansas that were formed between nineteen and twenty-eight years ago.

First, can the use of an essentially non-renewable groundwater resource for irrigation be effectively managed at the local level? Twenty-seven states permit the formation of special management areas to address local groundwater quantity problems; however, in only six states does a local board or commission constitute the decision makers for the specific areas to be managed.[12] One purpose of this study is to assess and compare the way that six groundwater management districts in two of these six states, Colorado and Kansas, approach the process of local groundwater management in the High Plains Ogallala region. (Figure 1)

Secondly, do states that have similar authority for local groundwater management and similar groundwater depletion problems produce the same type of local management institutions? This study describes the historical evolution of three local groundwater management districts in Colorado and Kansas and compares their authorized powers, management plans, future priorities and innovative strategies, both between states and among districts.

Thirdly, do irrigators in different districts exhibit similar or different perspectives about how groundwater use should be locally managed? This study examines the results of a survey of 330 irrigators to assess irrigators' perceptions of each district's strengths and weaknesses, and their degree of acceptance for broad management objectives as well as for more specific management options. Also assessed are irrigator attitudes concerning each district's overall effectiveness.

MANAGEMENT CONTEXT

Our impression is that local institutions have made a difference. In our previous studies of response to groundwater depletion in the High Plains, institutional variation frequently explained differences in preferred adjustments and irrigator choice of water-saving techniques.[13] The High Plains provides an excellent region in which to study the influence of law and institutions on water management. Both Kansas and Colorado operate on the basis of the "Doctrine of Prior Appropriation".[14] Ground-

12. Jean A. Bowman, *Ground-Water-Management Areas in the United States*, 116 J. Water Resources Plan. & Mgmt. 484 (1990).

13. David E. Kromm & Stephen E. White, *Adjustment Preferences to Groundwater Depletion in the American High Plains*, 15 Geoforum, 271 (1984); David E. Kromm & Stephen E. White, *Adoption of Water-Saving Practices by Irrigators in the High Plains*, 26 Water Resources Bull. 999 (1990).

14. Prior Appropriation is a concept in water law under which users who demonstrate

water management districts were authorized in 1965 in Colorado and 1972 in Kansas.

In both states, districts have broad management authority to include, recommending the rejection of requests for new wells, requiring well metering, well spacing, and pumping limitations, development of management plans, assessing special taxes, issuing bonds to finance irrigation systems, and organizing a Board of Directors to oversee and approve district operations. However, variation in the devolution of water management responsibility is significant. In Kansas, for instance, local districts have demanded great autonomy, whereas those in Colorado primarily carry out most state policies while opting to request local exception to others. Field work in the groundwater management districts in the study area reveal that all are at a high point in activity.

If districts are to be effective grassroots organizations, their initiatives and policies should come from their constituents and reflect their preferences so far as groundwater management is concerned.[15] In order to judge whether or not districts represent their local area, rather than just being spatially restricted to a local area, districts' policies and their outcomes are examined, the characteristics of board members determined, and the knowledge and support of district actions ascertained. Districts might approximate true grassroots organizations if they "create space for local idiographic knowledge".[16]

Management of groundwater has matured significantly in recent years, especially in western Kansas. The thrust has moved from controlling new irrigation development to reducing the water use of existing irrigators. The methods being used or considered, however, differ substantially among the districts. Districts within and between the two states have very different policies intended to bring about water conservation. Colorado and Kansas have approached the management of the High Plains aquifer differently. In Kansas, groundwater districts enjoy much more autonomy and have shown greater initiative in establishing new programs and policies. In Colorado, the State Ground Water Commission continues to be the source of policy change, though districts are permitted some leeway. Individual leadership clearly plays an important role in both states.

Public awareness and acceptance of district management philosophies also seem to vary tremendously. Some districts have a newsletter and work hard to use the media to their advantage. Others

---

earlier use of water from a particular source are said to have rights over all later users of water from the same source.

15. CHUCK KLEYMEYER, WHAT IS "GRASSROOTS DEVELOPMENT"?, 15 GRASSROOTS DEVELOPMENT 38 (1991).

16. FREEMAN, *supra* note 4 at 232.

readily admit that the community outside of agribusiness hardly knows they exist. This supports Nunn's view that public policy is collective action by "self-interested individuals."[17]

Another important issue confronting local groundwater managers is that of reducing conflict with state, federal, and local agencies whose programs sometimes discourage groundwater conservation at the local scale. For example, Consolidated Farm Services Agency (formerely Agricultural Stabilization and Conservation Service) subsidies support moisture-demanding corn, but not less water-intensive grain sorghum. Inter-institutional collaboration must take place if water management is to be effective.[18]

Assessment and comparison of the groundwater management district programs in Colorado and Kansas contributes to understanding the implications of varying institutional priorities on groundwater management and use. Surveying the irrigators in each district provides insights into what farmers know, what they prefer, and how well the districts function as grassroots organizations reflecting the popular will. The effectiveness of the districts and the perceptions of the irrigators constitute the most important social guidelines or influences in groundwater management in the High Plains.[19]

STUDY AREA

Western Kansas and eastern Colorado are part of the semi-arid High Plains that overlie a large aquifer system that is often referred to as the Ogallala after its main water-bearing formation (Figure 1). Rainfall in the study area ranges between 14 and 22 inches. The 1992 Agricultural Census reported that the Kansas portion supported over 1,972,864 total irrigated acres and Colorado supports approximately 827,777 acres. Together, the two states accounted for almost one-quarter of the harvested irrigated land in the High Plains (See Table 1). Corn and wheat are the primary crops grown, and livestock operations are widespread. The integrated agribusiness economy also includes large meat-packing plants in Kansas and Colorado.

The 1987 irrigated area declined significantly since its census high in 1978 because of declining water availability, the cost of pumping water from increasing depths, and federal soil conservation programs designed

17. Nunn, *supra* note 2.

18. K. Asit Biswas, *Water for Sustainable Development in the 21st Century: A Global Perspective*, 24 Geo. J. (1991).

19. W.R. Derrick Sewell, *The Contribution of Social Science Research to Water Resources Management in Canada, in* WATER: SELECTED READINGS 26 (J.G. Nelson & M.J. Chambers eds., 1969).

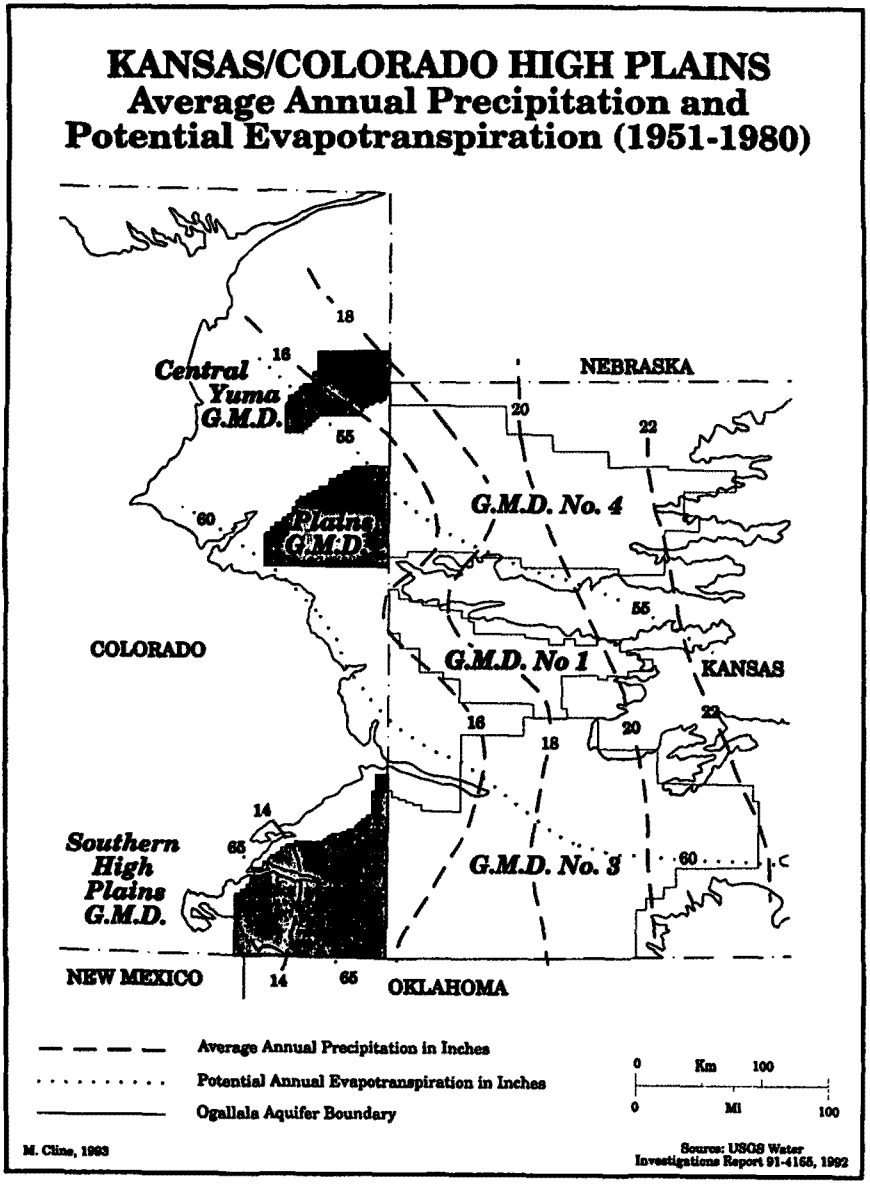
KANSAS/COLORADO HIGH PLAINS
Average Annual Precipitation and
Potential Evapotranspiration (1951-1980)
NEBRASKA
Central Yuma G.M.D.
Plains G.M.D.
G.M.D. No. 4
G.M.D. No 1
G.M.D. No. 3
Southern High Plains G.M.D.
COLORADO
KANSAS
NEW MEXICO
OKLAHOMA
18
16
55
20
22
60
55
16
18
20
22
14
65
60
14
65
Average Annual Precipitation in Inches
Potential Annual Evapotranspiration in Inches
Ogallala Aquifer Boundary
0 Km 100
0 MI 100
M. Cline, 1993
Source: USGS Water Investigations Report 91-4165, 1992

TABLE 1
HIGH PLAINS AQUIFER IN COLORADO AND KANSAS

	1978	1987	1992
	Irrigated Acres Harvested	Irrigated Acres Harvested	Irrigated Acres Harvested
	1978	1987	1992
Colorado	957,767	786,271	827,779
Kansas	2,077,720	1,783,419	1,972,864

Sources: Calculated from data in U.S. Bureau of Census, 1978, 1987, and 1992.

to take land out of production (Table 1). Kansas declined 17.8 percent from over 2,000,000 acres and Colorado 16.1 percent from approximately 958,000 acres. However, census data reveals that since 1987, total irrigated acres has increased by 10.7 percent in Kansas and 5.3 percent in Colorado. These increases can probably be attributed to the increasing demand for corn as the feedlot industry expands, and the relatively low energy prices during the 1987-1992 period. Thus, corn acreage showed the greatest increase in both states. With well over 12,500,000 irrigated acres, the High Plains remains the leading irrigation region in the United States.

Management of the High Plains aquifer varies from state to state with both Colorado and Kansas relying on locally-organized groundwater management districts. In Kansas each district includes several counties, whereas in Colorado most fall within a single county. As a rule, these districts correspond with the occurrence of the Ogallala aquifer and an intense level of irrigation. Outside the district boundaries there is less saturated thickness and far fewer irrigated farms. In these areas, dryland farming and pasture dominate.

The study area for this research is comprised of all three groundwater management districts ("GMD"s) in western Kansas and three of the largest in eastern Colorado. All are along an interstate boundary and in two cases, a district abuts another on the opposite side (Figure 1). The districts will be referred to by their name in Colorado and their number in Kansas.

DISTRICT OPERATIONS AND OBJECTIVES

An interdisciplinary group at Cornell University studied irrigation management worldwide, a project that led to a book by Uphoff,

Ramamurthy and Steiner on analyzing and improving management performance.[20] We will use their three points of reference to describe the groundwater management districts in Colorado and Kansas. The methodology for assessing the performance of irrigation bureaucracies begins with management structure, followed by management objectives, and ending with the context of irrigation management. Although their typology was designed primarily to analyze the varied forms found in irrigation water supply districts, it is an equally valid approach to describe groundwater management districts in Colorado and Kansas.

A. District Management Structure

In both states districts are governed by a board of directors elected by the public at either a general election (Colorado), or a widely publicized groundwater management district annual meeting (Kansas). Any adult land owner can serve on the boards in Colorado, while Kansas also requires a minimum holding of 40 contiguous acres. As the Kansas districts are multi-county, each county is represented on the board. The largest district in the study area, GMD No. 3 in southwest Kansas, also calls for three at-large positions which represent industrial, municipal, and dryland farming or domestic interests. In three districts, all the directors are irrigators. Six of seven directors are irrigators in Central Yuma GMD, thirteen of fifteen in GMD No. 3, and nine of eleven in GMD No. 4. Board size ranges from five persons in GMD No. 1 in west-central Kansas to fifteen in GMD No. 3. Terms run three years and incumbents are commonly re-elected. In most districts at least one elected director has served fifteen years, but GMD No. 4 has a two-term limitation. As of mid-1993, four of the seven members in Central Yuma had served at least ten years. Boards meet on a regular basis, usually quarterly or bi-monthly.

The boards hire a district manager or executive director and other staff as deemed necessary to carry out their policies. All but Southern Plains GMD in Colorado, where a part-time person handles some routine work for the district, have a full-time manager. Reflecting the smaller size of the Colorado districts, the manager in Central Yuma oversees four districts and the Plains GMD district manager is responsible for two. The managers for Central Yuma, GMD No. 1, and GMD No. 4 assumed their duties in the 1970s, whereas the managers in Plains and GMD No. 3 took their position in the early 1990s. Except for Southern Plains and Plains, each district has at least two full-time staff positions. Each of these

---

20. NORMAN UPHOFF ET. AL., MANAGING IRRIGATION: ANALYZING AND IMPROVING THE PERFORMANCE OF BUREAUCRACIES (1990).

districts has at least one full-time professional on its staff, and all six retain the services of legal counsel as needed.

B. District Management Objectives

The second consideration in describing district performance entails irrigation management objectives. Uphoff, et. al., claim that objectives establish criteria by which management can be evaluated.[21] Table 2 presents a summary of the rules and regulations of the six study districts. Certain restrictions, such as spacing of wells, limits on water use, and maximum allowable appropriations, are requirements defined by state law, though Kansas districts have historically demonstrated greater autonomy in setting restrictions. The water use limitations for irrigation range from 2.0 acre-feet per acre in GMD Nos. 1, 3 and 4 to 3.5 acre-feet per acre in Southern Plains GMD.

All six districts regulate well spacing, new well development, abandoned wells, and points of water diversion. Well spacing regulations minimize pumping interference, especially among high capacity wells having discharges of over 1,000 gallons per minute, and control the rate of groundwater depletion within a given area. Because of well spacing requirements, very little land is open for additional well drilling. Therefore, regulations governing new wells are, for all practical purposes, obsolete because the districts are closed to further irrigation development. Regulations governing abandoned wells require that they be appropriately handled to prevent groundwater pollution and hazards to individuals and animals. Water diversions must be approved prior to drilling.

Table 3 shows various special programs initiated by individual districts in order to accomplish objectives set by the state legislature or the local board of directors. For example, Colorado GMDs have implemented chemigation inspection programs to satisfy state law. Chemigation refers to the application of agricultural chemicals through center pivot sprinkler irrigation systems. GMD No. 1's active weather modification program serves part of GMD No. 3 and will likely spread to GMD No. 4 in western Kansas. This program attempts to enhance precipitation and suppress hail by using aircraft to seed clouds. Programs that educate the public about the role of the district and the need for water conservation serve an important role in several districts as do programs that provide water quality monitoring. On the whole, groundwater pollution problems are minimal in all six districts.

---

21. *Id.*

TABLE 2
SUMMARY OF GMD RULES AND REGULATIONS

Rules and Regulations	#1	#3	#4	Central Yuma	Plains	Southern Plains
Control Tailwater & Waste	*	*	*	*	*	
Enforce Well Spacing	*	*	*	*	*	*
Limit New Well Development	*	*	*	*		
Cap Abandoned Wells	*	*	*	*	*	*
Approve Change in Water Diversion	*	*	*	*	*	*
Develop Conservation Plans	*	*	*			
Implement Well Metering	*	*				
Meter Large Capacity Wells				*	*	*
Designate Alluvial Corridors			*			
Establish Well Construction Standards		*	*			
Set Allowable Appropriations		*	*	*		
Enforce Non-compliance		*	*	*		
Hold Hearing for Water Export				*	*	
Prohibit Supplemental Wells				*	*	
Close Areas to New Appropriations		*				
Enforce Water Use Limitations		*	*	*	*	*

Sources: Rules and Regulations of GMD 1, 3, 4, Central Yuma.
Report of District Activities within GMDA, Jan. 1992.
Policy Guidelines of the Colorado Groundwater Commission, Nov. 1990.

TABLE 3
SUMMARY OF GMD PROGRAMS

Programs	#1	#3	#4	Central Yuma	Plains	Southern Plains
Inspect Chemigation			*	*		*
Check Nitrate Levels				*	*	*
Provide Public Education	*	*	*		*	
Monitor Water Quality	*	*	*	*		
Collect Data*	*	*	*	*	*	*
Study Nitrate Occurrence			*		*	
Supervise Environmental Planning			*			
Operate Weather Modification	*					
Assist with Field Measurements	*					
Recommend Appropriation	*	*	*	*		

Sources: Report of District Activities within GMDA, Jan. 1992.
***KS: Water level, quality, rights appropriations, land ownership**
CO: Water level (in cooperation with Colorado Ground Water Commission)

A far-reaching program to achieve "zero depletion" of the aquifer is being debated in GMD No. 4 in northwest Kansas.[22] The district is considering a program package designed to achieve sustainable irrigation. The major components are setting minimum efficiency levels for all irrigation systems, introducing an operational weather modification program, bringing about changes in Federal farm crop support to include less water intensive wheat, sunflowers, and soybeans in place of high moisture demand corn,[23] and increasing the flexibility in using water rights to allow concentration of irrigation on the best land. Advocacy of "zero depletion" in GMD No. 4 has been widely reported in the regional press and elsewhere throughout the country.

C. Context of Districts' Irrigation Management

A final point of reference is the context of irrigation management. Uphoff et al. argue that local conditions affect what is possible and considered desirable and what determine the capacity for irrigation management.[24] Table 4 provides various characteristics of each district and its irrigated agriculture. The Colorado districts were founded earlier and are smaller. The larger Kansas districts have more irrigated acres and irrigation wells. Although not reflected by the data in table 4, larger farms with more irrigation wells are in operation in the southern reaches of both states.

In all but Central Yuma district the main crop is wheat, whereas the leading irrigated crop in all districts is corn. Farmers also irrigate wheat, grain sorghum, soybeans, and alfalfa for hay, and there is some dryland corn and soybeans to the north. Center pivot sprinkler irrigation prevails in all but GMD No. 1 where the land is flat and the well capacities relatively low. The mean percentage of land irrigated on a farm is over half in GMD No. 3 and over forty percent in GMD No. 4 and Central Yuma, but is one-quarter in Southern Plains GMD where much land is in pasture. The proportion of farms raising cattle is relatively high throughout, with about two-thirds of those in Colorado producing both cattle and crops.

---

22. Zero depletion or "sustainable yield" refers to withdrawing no more water from the aquifer than is being replaced through recharge.

23. John G. Lee & Ronald D. Lacewell, *Farm Program Impacts on an Exhaustible Groundwater Supply: An Analysis of the Texas Southern High Plains*, 26 Water Resources Bull. 8 (1990) (Federal farm programs have had a substantial impact on water use in the High Plains).

24. UPHOFF, *supra* note 19.

TABLE 4
DATA FOR DISTRICTS

District	Year Founded	Year Manager Started	Area in Acres	Irrigated Acres	% Sprinkler	Irrigation Wells	Population Estimate
#1	1975	1975	1,110,000	400,000	25	2,650	14,017
#3	1976	1992	5,722,000	1,612,191	42	9,884	114,800
#4	1976	1977	3,115,000	378,446	62	3,550	29,700
So. Plains	1974	1993	573,792	58,000	10-15	800	4,550
Plains	1967	1990	832,000	190,000	80-85	942	4,000
Central Yuma	1967	1972	500,000	72,000	92	450	5,000

Source: Survey of District Members

IRRIGATORS' PERCEPTION OF DISTRICTS' EFFECTIVENESS AND PRIORITIES

A. Survey Methodology

During the fall of 1992, an eight-page survey was mailed to 150 irrigators in five of the groundwater management districts and 105 irrigators in the Southern Plains GMD. The survey sample was systematically drawn from lists of irrigators provided by each district.[25] A follow-up survey was sent approximately two weeks after the first was mailed. A third and final request was mailed approximately three weeks after the second follow-up.

A total of 330 irrigators (38.9 percent) returned usable surveys. The response rate ranged from 53.3 percent for GMD No. 4, in Kansas, to just 17.1 percent for the Southern Plains GMD, in Colorado. From our field work, we feel that the low response for the Southern Plains GMD can probably be attributed to the lack of a fee assessment to support a district manager and a functioning district office. As expected, the overall response from Kansas irrigators was higher (45.6 percent) than that for Colorado (25.9 percent).

The survey solicited irrigators' responses to two categories of questions; 1) irrigator and farm characteristics, and 2) strengths, weaknesses, objectives, priorities, and administration of their respective groundwater management districts.

B. Irrigator Characteristics

The "mean" respondent for the entire study area is a 57-year-old man who has about 34 years experience farming, 25 years as an irrigator, and at least some college education. He farms over 2,100 acres and irrigates primarily corn with sprinkler systems on about 770 acres with 5 irrigation wells (See Table 5). Our field interviews suggest that the respondents' characteristics are representative of irrigators in each district. However, respondent characteristics do vary somewhat between states and among the districts.

Colorado farmers, on average, were irrigating about 43 more acres with one and one-half fewer wells than their Kansas counterparts. This does not suggest that Colorado irrigators are more efficient water users. Instead, it may indicate that they have higher volume wells and simply pump more water per well. Also, most eastern Colorado irrigators

25. The list for the Southern Plains GMD was provided by the Colorado Ground Water Commission.

have a larger groundwater appropriation (a maximum of 2.5 to 3.5 acre-feet per acre, depending on location) than do Kansas irrigators (a maximum of 2.0 acre-feet per acre). Unlike Kansas, there is no requirement that Colorado irrigators report their water use. Thus, it is difficult to compare pumpage rates between the two states. Another statistically significant difference is that Colorado farmers irrigate disproportionately more corn[26] and less wheat and grain sorghum. Also, the average farm size in Colorado (2,292 acres) is more than 300 acres larger than in Kansas. Differences in irrigator age, years in farming, years irrigating, and educational attainment were not statistically significant between the states.

Irrigator and farm characteristics among groundwater management districts statistically differ more than those between states (See Table 5). The range of values for the significantly different characteristics follow. Mean farm size ranges from 2,663 acres in the S. Plains GMD to 1,657 acres in GMD No. 4, whereas irrigated acres range from 1,340 in GMD No. 3 to just 402 in GMD No. 4. The chief crop grown in the Plains GMD is corn (78 percent of irrigators designated it their main crop), whereas only 16 percent identify corn as a chief crop in GMD No. 1, where wheat (61 percent) constitutes the dominant irrigated crop. About 64 percent of the irrigators in GMD No. 1 use only gated pipe surface irrigation.[27] In contrast, 71 percent of Central Yuma irrigators employ only sprinkler systems. Over 45 percent of the Central Yuma GMD irrigators have graduated from college whereas only 18 percent of those in Plains GMD have done so. Respondents in GMD No. 3 have been irrigating more than 6 years longer than those in GMD No. 4. Importantly, about 55 percent of all farm land in GMD No. 3 is irrigated. No other district comes close to that percentage. It is truly the dominant irrigation district in the study area both in terms of total area, and the intensity of irrigation. No significant differences occur among districts for age, total years farming, or the percentage raising livestock.

The variability of irrigator and farm characteristics among districts not only contradicts the public perception of a uniform High Plains, but it also strengthens the argument for local control. Uniform state or region-wide irrigation rules and management policies may not be equitable or functional among areas that have strikingly different levels of irrigation, farm size, and crop types.

---

26. For example, Colorado's corn irrigation accounts for 69.1 percent of all crops compared to 55.1 percent in Kansas.

27. Gated pipe irrigation is an irrigation system that delivers water to crops through a series of openings in a pipe placed at the upper end of a field. Gates are used to control the volume of water that flows from end openings into furrows.

TABLE 5
SURVEY RESPONSE MEANS BY DISTRICT

District	Wells Operating in 1992	Farm Acres	Irrigated Acres	Percent Irri-gated	Reduced Acres (%)	Live Stock (%)	Years Farmed	Years Irri-gated	Age	N
GMD #1	6.0	1,990.2	641.2	32.2	73.3	47.0	32.2	25.4	54.6	67
GMD #3	8.3	2,442.1	1,339.8	54.9	42.0	62.1	36.2	28.5	57.5	58
GMD #4	3.6	1,657.1	402.1	21.2	38.2	55.0	33.4	22.4	56.9	80
So. Plains	5.6	2,662.8	953.7	35.8	62.5	72.2	38.2	28.8	59.1	18
Plains	3.6	2,377.5	559.8	23.5	32.6	64.0	32.1	25.1	55.6	51
Cent.	4.2	2,085.4	947.3	45.0	22.4	66.1	33.1	23.5	58.4	56
Colorado	4.1	2,291.9	796.0	34.7	32.4	66.1	33.4	25.0	57.4	125
Kansas	5.6	1,987.2	752.8	37.9	51.1	54.4	33.8	25.1	56.5	205
Aggregate	5.1	2,100.3	769.4	36.6	43.9	58.8	33.7	25.0	56.9	330

C. *Perceived GMD Strengths and Weaknesses*

As a means of reinforcing our systematic evaluation of the districts, the survey elicited irrigators' views of performance. The following two open-ended questions were asked to assess the range of the GMDs' perceived strengths and weaknesses:

> 1) What are some of the strengths and accomplishments of your local groundwater management district, and
> 2) What are some of the weaknesses and shortcomings of your local groundwater management district?

The respondents provided 192 statements that focused on strengths and 121 that identified weaknesses. Irrigators' responses are categorized for the entire sample and for each district and state (See Tables 6 and 7). The number of categories is too large to permit a statistically valid contingency table analysis but several general patterns emerge that will be discussed in narrative form. The major strengths identified correspond very closely with the original intention of the groundwater management acts; controlling the waste of water, promoting local control and management, encouraging groundwater conservation awareness, limiting well permits and enforcing district rules and regulations. Collectively, irrigators appear to be saying that the districts' major accomplishments correspond with what the groundwater management acts suggest that they should be doing.

For each of four areas identified above as "strengths", patterns in the survey responses were evident. For example, ten of the twelve irrigators who mentioned programs to plug abandoned wells resided in GMD No. 4, and one-half of the respondents who noted programs to prevent chemigation pollution lived in the Central Yuma District. Also, irrigators in GMD No. 4 were much more likely to identify the role of the district in promoting local control as a major strength. By far, the major perceived strength of GMD No. 1 was its weather modification program. Although irrigators feel that the districts are generally doing what is authorized by the groundwater management acts, they are also quick to identify *unique* programs in their own district as strengths.

Irrigators were less inclined to mention district weaknesses than strengths. When they did, the sentiment was generally for more proactive policy in water management. Well over one-quarter of the responses identifying weaknesses suggest that irrigators are dissatisfied because districts either need more authority to manage groundwater adequately, or are too conservative and do not take advantage of the authority they currently hold. Also mentioned were dislikes for a particular manager or Board of Directors and a need for better communication between the district office and irrigators. A very few responses focused on pressures

TABLE 6
PERCEIVED GMD STRENGTHS
(Number of Responses)

	Total	C. Yuma	Plains	S. Plains	Col. Sub-Total	#1	#3	#4	KS Sub-Total
1. Control Water Use/ Prevent Waste	33	6	8	1	15	1	6	11	18
2. Promote Local Control	23	0	3	1	4	4	4	11	19
3. Promote Conservation Awareness	22	0	8	0	8	5	5	4	14
4. Enforce District Regulations	20	2	6	2	10	6	0	4	10
5. Prevent Chemigation Pollution	20	10	3	1	14	1	3	2	6
6. Limit Well Permits	20	1	2	1	4	4	4	8	16
7. Weather Modification	14	0	0	0	0	14	0	0	14
8. Plug Abandoned Wells	12	0	0	0	0	0	2	10	12
9. Represent Local Interest to State	10	2	1	1	4	2	1	3	6
10. Other	18	2	3	0	5	4	5	4	13
Total	192	23	34	7	64	41	30	57	128

TABLE 7
PERCEIVED GMD WEAKNESSES
(Number of Responses)

	Total	C. Yuma	Plains	S. Plains	Col. Sub-total	#1	#3	#4	KS Sub-Total
1. GMD Lacks Authority	24	2	8	2	12	5	5	2	12
2. Don't like GMD Personnel/Board	15	3	3	1	7	1	3	4	8
3. Lack of Communication	14	1	4	1	6	0	6	2	8
4. Unfair Policies	12	2	3	1	6	2	2	2	6
5. Too Conservative	10	2	1	0	3	1	5	1	7
6. Other	46	15	3	1	19	6	5	16	27
Total	121	25	22	6	53	15	26	27	68

placed on irrigators to conserve water or specific district management or enforcement issues. Generally, the responses indicated that the respondents want more, not less, groundwater management.

D. Preferences for GMD Objectives and Management Options

Do Colorado and Kansas irrigators share a common mentality about broad GMD objectives and specific management options? Do they exhibit a common irrigator culture which influences their preferences for particular management strategies? The responses from several of the survey questions are examined to answer these questions.

Four survey questions asked irrigators to assess the level of agreement for four broad groundwater management district objectives: 1) reduce groundwater depletion; 2) monitor water quality; 3) enforce rules and penalize violators; and 4) sustain the life of the aquifer for a specified period of time (See Table 8). About two-thirds of the irrigators in both Colorado and Kansas agree that GMDs should take active roles in reducing groundwater depletion and monitoring water quality. But respondents differ when it comes to specifics. Only about one-half feel that sustaining the life of an aquifer for a specified period should be a valid GMD objective. Importantly, about one-third of Kansas irrigators and one-fourth of those in Colorado are undecided on this issue, whereas only one-fifth are *not* in favor of the objective. This suggests that while irrigators are generally in favor of reducing groundwater depletion, many remain uncertain that "managed depletion" is a worthwhile objective.

Enforcement of rules (such as eliminating tail-water runoff, maintaining well spacing requirements, and not exceeding appropriated use) is another area in which irrigators disagree. While a slight majority are in favor of enforcement, there is a large contingent of irrigators who are either opposed to enforcement or undecided. Irrigators appear to be saying that they support reducing depletion and monitoring water quality only in principle. However, almost half do not support a "managed depletion" process nor do they want the GMDs to insure that groundwater is not wasted by enforcement.

Although irrigators widely disagree as to the validity of the four broad-based management objectives, there are no significant differences in the levels of support between states or among districts. That is, the conflict over acceptable objectives occurs in a similar fashion throughout all six GMDs. This is not the case when irrigators are asked about more specific management options rather than broad objectives.

Six survey questions examined irrigator preferences for more specific management options to include: 1) requiring water meters; 2) adopting weather modification; 3) taxing water rights; 4) reporting water use; 5) limiting irrigation to protect wetlands, streams or the rights of

TABLE 8
BROAD GROUNDWATER MANAGEMENT OBJECTIVES

Question	Response Categories	Response Percentages By Groundwater Management Districts									
		Colorado				Kansas					
		C. Yuma	Plains	S. Plains	Sub Total	#1	#3	#4	Sub-Total	Significant Differences	
Do you believe that your local groundwater management district should take an active role in *reducing groundwater depletion?*	Yes	79.2	74.0	52.9	73.3	67.2	64.9	63.2	65.0	States	None
	No	15.1	14.0	29.4	16.7	12.5	19.3	14.5	15.2	Districts	None
	Undecided	5.7	12.1	17.6	10.0	20.3	15.8	22.4	19.8		
Should groundwater management district actively *monitor water quality* and report problems to the state?	Yes	86.0	64.6	38.9	69.8	64.5	61.8	63.2	63.2	States	None
	No	8.0	20.8	33.3	17.2	19.4	20.0	17.1	18.7	Districts	None
	Undecided	6.0	14.6	27.8	12.9	16.1	18.2	19.7	18.1		
Should a local groundwater management district be given the power to *enforce penalties* (fine, shut down) against groundwater management policy violators?	Yes	74.5	53.1	41.2	60.7	56.5	52.8	54.8	54.8	States	None
	No	13.7	20.0	41.2	20.5	19.4	32.1	26.0	25.5	Districts	None
	Undecided	11.8	26.5	17.6	18.8	24.2	15.1	19.2	19.7		
Should groundwater management districts attempt to *sustain life of an aquifer* for a specified period of time?	Yes	63.3	51.0	53.3	56.6	44.8	49.1	45.7	46.4	States	None
	No	16.3	22.4	13.3	18.6	22.4	22.6	15.7	19.9	Districts	None
	Undecided	20.4	26.5	33.3	24.8	32.8	28.3	38.6	33.7		

TABLE 9
SPECIFIC GROUNDWATER MANAGEMENT OPTIONS

Question	Response Percentages By Groundwater Management Districts										
	Response Categories	Colorado				Kansas					
		C. Yuma	Plains	S. Plains	Sub Total	#1	#3	#4	Sub-Total	Significant Differences	
Should *water meters* be required on irrigation wells	Yes	39.2	14.9	22.0	26.7	38.7	52.6	39.0	42.9	States	.05
	No	45.1	68.1	44.4	54.3	43.5	33.3	46.8	41.8	Districts	.05
	Undecided	15.7	17.0	33.3	19.0	17.7	14.0	14.3	15.3		
Should your local groundwater management district support a *weather modification* program?	Yes	34.7	30.4	31.3	32.4	76.2	54.4	51.3	60.2	States	.01
	No	42.9	32.6	50.0	39.6	15.9	26.3	19.7	20.4	Districts	.01
	Undecided	22.4	37.0	18.8	27.9	7.9	19.3	28.9	19.4		
Should a water right be *taxed* as is done with other property rights?	Yes	10.2	27.1	0.0	15.7	8.2	7.0	12.2	9.4	States	None
	No	83.7	62.5	83.3	74.8	85.2	87.7	81.8	84.4	Districts	.05
	Undecided	6.1	10.4	16.7	9.6	6.6	5.3	6.8	6.3		
Should irrigators be required to estimate and *report their water use*?	Yes	33.3	18.8	43.3	28.7	71.4	86.8	80.8	79.4	States	.01
	No	49.0	54.2	31.3	48.7	23.8	11.3	8.2	14.3	Districts	.01
	Undecided	17.6	27.1	25.0	22.6	4.8	1.9	11.0	6.3		
Should local groundwater management districts have the power to *limit irrigation to protect* wetlands	Yes	37.8	40.0	14.3	35.2	30.2	20.8	25.0	25.3	States	None
	No	62.2	60.0	85.7	64.8	69.8	79.2	75.0	74.7	Districts	None
stream flow	Yes	53.7	51.2	13.3	46.4	37.0	27.5	33.9	32.9	States	.01
	No	46.3	48.8	86.7	53.6	63.0	72.5	66.1	67.1	Districts	.05
the rights of other users	Yes	71.1	80.0	76.5	75.7	73.2	79.6	77.3	76.7	States	None
	No	28.9	20.0	23.5	24.3	26.8	20.4	22.7	23.3	Districts	
Would you favor increased assessments to support the GMD if the increased revenue is matched by the state to cost share water saving devices?	Yes	57.1	57.1	46.2	55.7	58.2	44.2	46.9	49.7	States	None
	No	42.9	42.9	53.8	44.3	41.4	55.8	53.1	50.3	Districts	None

other water users; and 6) assessing fees to cost-share water saving devices (See Table 9). The concept of a shared "irrigator culture" loses validity in the context of preferred management options for two reasons. First, irrigators are divided over the acceptability of several options and, secondly, the level of acceptance for specific options varies significantly among districts and between states.

Kansas irrigators are evenly divided over whether or not water meters should be required, while only about 22 percent of those in Colorado support mandatory metering. Kansas irrigators support weather modification, whereas, Colorado irrigators oppose it. Likewise, Kansas irrigators strongly support the requirement to report water use, but Colorado irrigators strongly reject it. Irrigators in both states are very divided over the option of increasing assessments to support GMDs and cost-sharing water saving devices with the state.

Differences in irrigators' preferences for management options correspond with differences in state requirements. For example, Kansas requires water-use reports while Colorado does not. Recently, some Kansas GMDs have required new irrigators to meter water use in specified areas, while the rest are being required to do so in the future as locally initiated plans for meter phase-ins become effective. Colorado irrigators are not required to meter water use. Weather modification occurs in parts of Kansas but not in Colorado. Perhaps irrigator responses suggest that many are happy with the status quo. It may also be that differences, in part, reflect local initiatives.

Irrigators in both states are in strong agreement about two issues. First, most agree that property taxes should not be assessed against water rights. Only nine percent of irrigators in Kansas and 16 percent in Colorado support this option. Also, irrigators in both states are strongly opposed to limiting irrigation use in order to protect wetlands or instream flows. On the other hand, more than three-fourths agree that limiting irrigation use is necessary if it must be done to protect the rights of other irrigation users.

E. Irrigator Perception of GMD Effectiveness

Irrigators were asked to evaluate two criteria which gauge local groundwater management effectiveness. Specifically, 1) does the district generally represent their interest; and 2) to what degree are the groundwater laws and policies for the local area fair, restrictive, or permissive (See Table 10). More respondents feel that the GMDs do represent their interests than not. However, approximately 40 percent are undecided. The degree to which irrigators are undecided is consistent across all six districts. While some of the undecided irrigators may simply not know much about the district in which they farm, our results suggest that

groundwater managers must strive to work with irrigators in order to develop comprehensive management strategies that will be acceptable to those served and regulated.

Only a slight majority of irrigators feel that the word "fair" describes the legal and political context within which the districts operate. Nonetheless, there is substantial disagreement among irrigators as to whether or not the words "restrictive" or "permissive" describe current policies and regulations. In Colorado, more irrigators feel that "restrictive" is a better descriptor than "permissive"; however, in Kansas the opposite is true. Interestingly, Kansas irrigators actually have more restrictive "hoops" to jump through than do Colorado irrigators.[28] Also interesting is that Kansas irrigators in the most restrictive, but proactive, district, GMD No. 4, evaluated their legal and policy context as more permissive than those in other districts. Perhaps irrigators' regulatory expectations are higher when more restrictions are already in place. It is also possible that greater irrigator support for management policies occurs in Kansas because most Colorado regulations are initiated by the state, whereas many in Kansas are locally drafted.

In summary, the survey responses indicate that disagreement within districts are much greater than those between districts in gauging GMD responsiveness to individual irrigator interests.

ASSESSMENT OF POLICY IMPLEMENTATION

Conceptualization of the analysis of policy implementation evolved rapidly in the 1970s, reaching an important benchmark with Mazmanian and Sabatier's development of a set of propositions regarding the conditions of effective implementation.[29] Our assessment of the performance of the six groundwater management districts in Colorado and Kansas is largely based on a modification of Mazmanian and Sabatier's evaluative criteria for effective implementation. They include (1) clear and precise objectives, (2) valid causal theory, (3) adequate financial resources, (4) committed and skillful implementing officials, and (5) external support for goals.[30] As a means of avoiding a sense of

28. For example, some areas require mandatory metering, water use reporting, and pre-appropriation water-use plans. Also, the state may designate Intensive Groundwater Use Control Areas to prevent new development or to reduce water use.

29. DAVID A. MAZMANIAN & PAUL A. SABATIER, EFFECTIVE POLICY IMPLEMENTATION (1981); Kem Lowry, *Assessing the Implementation of Federal Coastal Policy*, 51 J. Am. Plan. 288 (1985); Paul Sabatier, *Top-Down and Bottom-Up Approaches to Implementation Research: A Critical Analysis and Suggested Synthesis*, 6 J. Pub. Pol'y (1986).

30. In their original construction, Mazmanian and Sabatier include the five criteria mentioned and two others: extent of hierarchical integration within and among implementing institutions and extent to which decision-rules of implementing agencies are supportive of statutory objectives.

TABLE 10

	Response Categories	Colorado				Kansas			
		C. Yuma	Plains	S. Plains	Sub Total	#1	#3	#4	Sub-Total
Does your local groundwater management district generally represent your interest?	Yes	42.3	56.9	52.9	50.0	53.2	42.6	43.7	46.7
	No	19.2	3.9	27.8	11.7	8.1	16.7	12.7	12.3
	Undecided	38.5	39.2	36.3	38.3	38.7	40.7	43.7	41.2
How well do the following describe groundwater law and policy in your area?									
Fair	Describes well	56.5	59.3	*	59.6	46.4	48.1	50.0	48.2
	Descriptive	30.4	29.6	*	29.8	42.9	33.3	39.3	38.6
	Does not describe	13.0	11.1	*	10.5	10.7	18.5	10.7	13.3
Restrictive	Describes well	57.1	30.0	*	40.5	20.0	29.2	40.0	29.7
	Descriptive	21.4	40.0	*	32.4	45.0	50.0	35.0	43.8
	Does not describe	21.4	30.0	*	27.0	35.0	20.8	25.0	26.7
Permissive	Describes well	30.8	29.4	*	28.1	21.1	36.4	42.9	33.9
	Descriptive	38.5	17.6	*	31.3	42.1	0.0	23.8	21.0
	Does not describe	30.8	52.9	*	40.6	36.8	63.6	33.3	45.2

*Responses too few for meaningful interpretation.

"top-down" bias, an appraisal will also be made of public participation in formulating district policies and programs as advocated by several authors.[31]

A. Nature of Districts' Objectives

The general objectives of the groundwater management districts in Colorado and Kansas are exposed in the enabling legislation of both states, and, as discussed previously, individual districts have adopted clearly stated rules, regulations, and programs. When ambiguity exists as to what local districts are authorized to do, state courts have usually ruled in favor of the local districts. Aspects of the milestone "zero depletion" program under development in GMD No. 4 may further test the power of districts in formulating policy independent of the state.

In 1965, the Colorado state legislature passed an act which called for the formation of local groundwater management districts. Groundwater that does not contribute naturally to surface streams and does not affect vested surface-water rights is termed "non-tributary" and comes under the overall jurisdiction of the Colorado State Ground Water[32] Commission. The Commission designates groundwater basins and determines the allocation and administration of water rights within these basins, with day-to-day administration and management left to the groundwater management districts.[33] Districts may be locally formed with approval of the Ground Water Commission, and nine presently exist in the High Plains aquifer region. The broad management authority of the districts includes "Well-spacing, pumping limitation, groundwater recharge, planning, research, and regulation of use." The districts also have taxing power and may make special assessments.[34] None of the districts exercise the full range of authority made possible by the enabling act.

In Kansas, overall authority over the waters of the state is in the hands of the Chief Engineer of the Division of Water Resources who is directed "to conserve, control, allocate, regulate, and aid in the distribution of state waters".[35] Autonomous groundwater management districts

---

31. See, e.g., ELIZABETH H. HASKELL & VICTORIA S. PRICE, STATE ENVIRONMENTAL MANAGEMENT: CASE STUDIES OF NINE STATES (1973); Sabatier, *supra* note 28; DAVID L. FELDMAN, WATER RESOURCE MANAGEMENT: IN SEARCH OF AN ENVIRONMENTAL ETHIC (1991).

32. "Ground water" is legally two words in Colorado.

33. HIGH PLAINS ASSOCIATES, INSTITUTIONAL ASSESSMENT, SIX-STATE HIGH PLAINS OGALLALA AQUIFER REGIONAL RESOURCES STUDY (1982) (a report to the U.S. Department of Commerce and the High Plains Study Council).

34. *Id.*

35. *Id.*

were permitted by the state legislature in 1972. These districts were authorized to provide for the proper management and conservation of groundwater resources, prevent the economic deterioration of irrigated agriculture and associated endeavors, and secure the benefits of fertile soils and favorable locations with respect to national and world markets. The districts possess the following authorities: 1) the right to purchase, hold, sell, convey, and contract for land, water rights, and personal property; 2) acquire land by gift, exchange, or eminent domain; 3) construct public works related to water drainage, recharge, storage, distribution, and importation; 4) levy water user charges, land assessments and issue general bonds; 5) conduct research and disseminate results; and 6) install or require the installation of meters to determine groundwater withdrawal.[36] The Division of Water Resources remains the primary water rights agency and all district actions must be consistent with existing state law governing groundwater.[37] However, the districts may recommend whether or not a water right should be granted based on compliance with local restrictions. The districts also frequently recommend groundwater policies to the state.

Roberts notes that in Kansas regulatory power lies with the "local groundwater management districts by recommendations to the Kansas chief engineer," whereas in Colorado it lies with the "State Ground Water Commission in designated basins," while local groundwater management districts may enforce stricter regulations.[38] In Kansas, local initiative prevails, but is subject to the veto of the State Engineer. In Colorado, the State Ground Water Commission exercises most regulatory power, though local districts may develop their own policies and regulations.

Both Colorado and Kansas are prior appropriation states with regard to groundwater. A permit is granted to an irrigator (or other user) to consume no more than a specified amount of water in a calendar year. The water must be put to "beneficial use" for such things as irrigation, electrical power generation, or manufacturing. In recent years rights have been requested for new beneficial uses such as instream flow and wetlands protection. If water is not put to an approved use, the water right may be lost. If there is not enough water to go around for all users, prior appropriation doctrine mandates the reduction or elimination of water for those holding junior rights by date of granting. This gives rise to the expression "first in time, first in right." For the most part, water

---

36. *Id.*

37. John C. Peck, *Groundwater Management Institutions in Kansas*, 112 J. Irrigation & Drainage Eng'g 203 (1986).

38. Rebecca S. Roberts, *Groundwater Management Institutions, in* GROUNDWATER EXPLOITATION IN THE HIGH PLAINS 92 (David E. Kromm & Stephen E. White, eds., 1992).

rights in the High Plains of Colorado and Kansas have not been taken away because of nonuse or insufficient water to provide for all right holders.

B. Causal Theory

Mazmanian and Sabatier's second factor in achieving effective bureaucratic implementation calls for a sound theory as to what kinds of actions will result in the achievement of goals. This "causal theory" should give officials sufficient jurisdiction and leverage to obtain objectives.[39] Beyond functioning within the system of permitting water rights based on the doctrine of prior appropriation, there is no explicit causal relationship linking the enabling legislation for groundwater management districts and achieving specific goals. A sense of mission is missing. The goal of the districts in Colorado is a vague form of local management. In Kansas, the enabling act specifies conservation of groundwater resources and protection of economic well-being.

The weakness in causal theory is partially compensated for by the authority given the districts. Colorado GMDs may limit pumping, facilitate groundwater recharge, and require spacing between wells. Kansas districts are authorized to do far more than Colorado districts and have generally been more active. Both have revenue generating power. Nonetheless, the lack of clear direction and expectation has resulted in districts searching for a role, and, in a few cases, doing little more than routine record keeping for several years at a time. The enabling acts in both states allow for local initiative that has not always been forthcoming.

C. Financial Resources

Another key to successful bureaucratic implementation is adequate financial resources. Districts are allowed to tax irrigated land (Kansas) and groundwater use (both) up to a specified level. Kansas districts may also issue bonds. All but Southern Plains GMD currently collect an annual charge, although none assess the full amount to which they are entitled. Southern Plains may seek voter approval for an assessment at the 1996 general election. The district had been inactive in the 1980s. The resource base of the larger Kansas districts generates sufficient funds to maintain a full-time staff of at least two persons, and additional part-time help. The Colorado groundwater management districts are much smaller and are able to hire a full-time manager only

---

39. Kem Lowry, *Assessing the Implementation of Federal Coastal Policy*, 51 J. Am. Plan. Ass'n 288 (1985).

through joint efforts with other districts. All districts in both states are strapped for funds and would find it difficult to assume additional responsibilities or begin new programs.

D. Leadership

A fourth factor in evaluating district performance is the leadership of committed and skilled officials. It is clear that the five managers serving at present are all able persons committed to the well-being of their districts. We sense that the overall quality of present leadership is the best that it has ever been. The groundwater management profession is attracting good people. This has not always been the case. More than one district has languished with a manager of limited ability and motivation.

Today's leadership and vision are constrained by political reality. Managers are often hesitant to initiate programs to achieve a more sustainable irrigation economy or pursue district involvement in mandating more efficient water use. Instead, some managers place a higher priority on maintaining friendly relations with the elected board they serve, and with the irrigators, the major stakeholders. Thus, much more could be done than most managers are willing to do. For the most part, district managers have not actively pursued what Gilbert White calls "multiple means of reaching multiple goals".[40]

E. External Support

Finally, Mazmanian and Sabatier point out the importance of external support for the goals of the bureaucratic organization. If an agency is to succeed in its endeavors, there must be support from its constituency groups and key political figures. In both Colorado and Kansas, the groundwater management districts have strong advocacy from their responsible state office, the Ground Water Commission and the Division of Water Resources, respectively. It is probable that state officials support the concept of voluntary local control more than the total relinquishment of state authority to the districts. It is therefore likely that state officials would welcome the districts taking a more assertive role, especially in the area of limiting water use.

Determining support from constituency groups first requires identification of these groups. Earlier in this article, the views of the most visible constituents, irrigators, were discussed in detail. Among irrigators

---

40. GILBERT F. WHITE, STRATEGIES OF AMERICAN WATER MANAGEMENT 101 (1969).

there is agreement with, or uncertainty about, most district policies and potential programs. Outright opposition is usually not strong. Generally, other major users of water such as cattle-feeding operations and meat-processing plants do not have difficulty obtaining water rights, often purchasing them from irrigators. Districts are increasingly interested in securing water rights for industrial use because such use provides employment opportunities and promotes public welfare. Townspeople and most businesses consume relatively little water and are viewed less as constituents. Environmental interests occasionally make themselves "constituents" through promotion of specific policies such as maintaining instream flow and wetlands protection. Overall, there is constituent support for the groundwater management districts, as they largely practice what Feldman terms "constituency-based decision making".[41]

F. Assessment of Public Participation

Groundwater management districts in the High Plains aquifer region were formed to achieve local control of groundwater management. The districts' enabling acts empowered local people to take a more active role in their destiny. By having locally-elected boards establish policy, the districts avoid the bureaucratic indifference and professional biases often seen in state and federal agencies. The operations of the six districts differ markedly suggesting responsiveness to local preferences and conditions. Supporters of the groundwater management districts believe that they provide true democratic participation. Still, there remains the question as to whose interests are being favored and whose are being ignored.

If the districts are to be effective grassroots organizations, their initiatives and policies should come from the people and reflect popular preference so far as groundwater use is concerned.[42] In previous research projects we have surveyed the general public in southwest Kansas and throughout the entire High Plains—Ogallala aquifer region. We have found that local preferences generally agree with the priorities of the local district. Indeed, most respondents far more favored programs existing in their own districts than policies not pursued locally. The groundwater management districts appear to us to largely reflect the local popular will.[43]

---

41. FELDMAN, *supra* note 30 at 3.

42. Kleymeyer, *supra* note 14.

43. See, David E. Kromm & Stephen E. White, *Adjustment Preferences to Groundwater Depletion in the American High Plains*, 15 Geoforum, 271 (1984); David E. Kromm & Stephen E. White, *Variability in Adjustment Preferences to Groundwater Depletion in the American High Plains*, 22 Water Resources Bull. 791 (1986).

Public participation is considered important in local management and helps assure a broader agenda.[44] Is there direct public participation in the groundwater management districts? The answer is essentially no. Few people appear at regularly scheduled board meetings or more widely publicized meetings held for public input. Not many cast votes in the elections for board members. Even the media report little of what goes on in district board meetings. Open conflicts seldom occur, with consensus being the mode of operation. It is probable that most residents do not view district activities as affecting them. It is also likely that there is general agreement among informed residents within a district as to how the High Plains aquifer should be managed. Of those who disagree, few have a coherent alternative that they would be willing to advocate at a district board or public meeting. Public participation remains weak, but the popular will appears to be served. The activities of each district are probably consistent with local traditions.

CONCLUSION

Based on our field work within the region, a systematic assessment of performance, and a survey of irrigators, we believe that most of the groundwater management districts in the High Plains of Colorado and Kansas are reasonably effective in managing the aquifer and meeting the needs and preferences of their constituents. Discussions with a wide array of state and local officials, farmers and other area residents, and agricultural professionals in the public and private sectors reveal very strong support for the idea of local groundwater management and general agreement with most of the programs initiated by the districts.

Using a methodology for assessing the performance of irrigation bureaucracies developed by Uphoff, Ramamurthy, and Steiner, we determined that the groundwater management districts had a representative management structure with elected board managers and generally qualified managers, explicit rules and regulations, and local conditions facilitative of management. Most notable were innovations in Kansas districts such as an active weather modification program, consideration of a "zero depletion" policy, and a mandatory water metering program.

Policy implementation was assessed through use of a set of propositions developed by Mazmanian and Sabatier. The groundwater management districts have powers and responsibilities specified by state statutes and generally have the legal and revenue-generating authority to accomplish their tasks. A state-local partnership exists in both states,

---

44. FELDMAN, *supra* note 30.

though Kansas districts enjoy greater autonomy. A strong sense of "proactive" mission is missing. Anticipated opposition to higher taxes and weak managers have resulted in financial burdens that have caused virtual termination of one district and inaction by another during the 1980s. Overall, managers and the elected boards could do more and still be within their authorized powers. Only one district in each state has challenged the limits to their authority.

As a means of reinforcing our evaluation, we surveyed irrigators in each district as to their view of GMD strengths and weaknesses and their preference for GMD objectives and management options. The responses suggest the districts' accomplishments correspond with enabling act mandates. Furthermore, while irrigators support what their local district is doing, there is sentiment for a more proactive policy in water management. Although about two-thirds of the irrigators in both Colorado and Kansas agree that GMDs should take active roles in reducing groundwater depletion and monitoring water quality, they differ significantly when it comes to specifics. The variation in acceptance of objectives occurs in a similar fashion throughout all six GMDs, but specific management choices have major support only when they are already in practice.

Most of the groundwater management districts in the High Plains of Colorado and Kansas have expanded their role over the years and have taken an increasingly active stance toward conserving the regional aquifer. Irrigators have supported local management and usually agree with the policies instituted by their local district. Irrigators are part of the process of establishing more proactive groundwater management programs. A new vision expressed by a greater commitment to more sustainable irrigation practices is emerging. Future success in protecting the High Plains aquifer depends on whether groundwater management districts adopt this vision as their mission.