

COMPARATIVE WATER LAW AND MANAGEMENT: THE
YELLOW RIVER BASIN IN WESTERN CHINA AND THE STATE OF
KANSAS IN THE WESTERN UNITED STATES

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I. INTRODUCTION

Given the dramatic differences between the Yellow River Basin of China ("the Basin") and the river basins and aquifers of Kansas, and given the equally dramatic differences in the political histories and legal cultures that produced their respective water laws and water policies, a comparison between these laws and policies may appear quixotic or odd. Yet during the last three

decades, these two disparate places have come to share several important characteristics regarding water management.

Water allocation is a serious problem faced by both western China and the western United States, including Kansas. These regions share similar geo-hydrological conditions and economic characteristics, such as large-scale irrigated agriculture in arid and semi-arid regions, large wheat and corn production, the drying up of rivers, groundwater over-exploitation, water rights transfers from irrigation to industrial and municipal uses, and growth in their dairy and meat industries. However, the Chinese and western American approaches to water allocation are markedly different. Most importantly for this article, their respective laws differ fundamentally. The water law of Kansas and other western states is grounded upon the principle that water rights are private property rights, while China's water law does not recognize water rights as private property rights, and is instead grounded on governmental management at various levels. Part I of this Article provides a brief historical summary, to show how the Basin and Kansas have come to share a series of water realities. Part II of this Article surveys the most important water-supply problems in the Basin and in Kansas. Part III surveys their respective water laws and water management and allocation programs, with particular attention to water rights transfers, to show how the Chinese and Kansas systems have sought to address these problems.

II. THE MODERN CONVERGENCE OF THE YELLOW RIVER BASIN AND KANSAS

China is ancient, and so are its waterworks. According to legend, many of the rivers of northern China were diverted by the great engineer-emperor Yu, who dredged and ruled between 2205 and 2198 B.C. as one of the Three Sages of the Hsia Dynasty, the first in Chinese history.¹ Large flood control works and irrigation projects in China date from the seventh century B.C.; many of these diversions, such as that of the Min River in Sichuan Province, continue to operate.² The largest span of Chinese history—viewed crudely as the two millennia between the unification of China under the Ch'in in 221 B.C. and the fall of the last Ch'ing emperor in 1911—provides vast histories of water resource management, of regional and inter-regional water projects, and of water conflicts.³ Between 605 and 610 A.D., the emperor Sui-Yang-di supervised the construction of the 1747 km long Grand Canal, linking the

1. CHARLES O. HUCKER, CHINA'S IMPERIAL PAST: AN INTRODUCTION TO CHINESE HISTORY AND CULTURE 23 (1975).

2. See ALASDAIR CLAYRE, THE HEART OF THE DRAGON 136 (Collins/Harvill 1984); see also HUCKER, *supra* note 1, at 44 (describing the same irrigation system from the perspective of the Chengtu region).

3. See RANDALL A. DODGEN, CONTROLLING THE DRAGON: CONFUCIAN ENGINEERS AND THE YELLOW RIVER IN LATE IMPERIAL CHINA 1-3 (2001). The Grand Canal still operates, connecting Beijing in the north with Hangzhou in the south, a distance of over 1,110 miles. *Id.*

Yangtze and Yellow Rivers through a series of canals and the natural waterways of east-central China, greatly strengthening the social and economic connections between north and south.⁴

From at least the sixth century A.D. onward, China maintained centralized control of large water projects, developed them as state enterprises, and managed them with its vast bureaucracy. Even the Mongols, detested by the Han Chinese as outsiders, rebuilt the Grand Canal and extended it to Beijing during the thirteenth century.⁵ The revolutionary states that succeeded late imperial China, first the Republic of China (1911-1949) and especially the People's Republic of China (1949-present), did not change these essentials of water policy.⁶ Under Mao Zedong, China harnessed three cardinal creations of post-Enlightenment Europe—the nation-state, political ideology, and modern industry—to build and to realize water projects of enormous scale. (For example, Mao irrigated nearly eight million hectares of land in three months, a project made possible through the labor of 100 million peasants.⁷) Communist China, from the Great Leap Forward to the Cultural Revolution, consciously attempted a permanent, comprehensive, and revolutionary break with its dynastic past.

During the 1980's, however, China began to evolve beyond communism, as it embraced the global market economy. Unlike the Soviet Union, China retained the structure of its communist state, its central command of the national economy, its central bureaucracy, and its planning of titanic state water projects. Chief among these is the Three Gorges Dam, which is filling a reservoir as long as Kansas is wide (400 miles), and which has already forced the relocation of over one million farmers. China plans to add the equivalent of another Three Gorges Dam every two years by 2020.⁸ From the Great Wall to the Three Gorges Dam, China has steadfastly remained a vast and centralized state, with commensurate water infrastructure.

Nonetheless, China's entrance into the world economy has brought about important legal changes in its water law and policy, which run counter to its long traditions—at first feudal, and then communist—of subordinating law to the exercise of state power.⁹ This change has in turn established a new legal framework for water rights, the 1988 China Water Law and its 2002 revision. Early in the twenty-first century, China has accomplished a new legal framework for water rights and water management that seeks to promote efficient water management and articulate water rights without compromising the centralized administration of water rights and the state's ownership and

4. HUCKER, *supra* note 1, at 138.

5. *Id.* at 286-87.

6. Patricia Wouters et al., *The New Development of Water Law in China*, 7 U. DENV. WATER L. REV. 243, 247 (2004) [hereinafter *The New Development*]; see generally LESTER ROSS & MITCHELL A. SILK, ENVIRONMENTAL LAW & POLICY IN THE PEOPLE'S REPUBLIC OF CHINA 1-3 (1987).

7. JONATHAN D. SPENCE, *THE SEARCH FOR MODERN CHINA* 547 (2d ed. 1999).

8. Shai Oster, *Three Gorges Dam Forces Another Move*, WALL ST. J., Feb. 7, 2009, at A6.

9. *The New Development*, *supra* note 6, at 247.

control of water resources.¹⁰

By contrast, the histories of the Anglo-American legal tradition, and of water's place within them, are largely histories of weakness, in which absolutism was effectively frustrated, private property rights were established early, and the exertions of centralized state power were long delayed. The historical accidents of early modern Britain frustrated the development of absolutism in England: while France and Spain emerged from their wars of religion as absolute monarchies, England emerged from its wars of religion as a limited one. Impoverished by wars, the late Tudors and the early Stuart monarchs came to depend upon Parliament for money, which in turn came to fear absolutist efforts to claim private property.¹¹ Such fear largely produced the British civil wars of the 1640's and the revolution of 1688-89, which was "Glorious" principally because of its opposition to "popery and arbitrary government"—specters that threatened the security of title to private property.¹² Although the power of the English (and, after 1707, British) state grew tremendously during the seventeenth and eighteenth centuries, it did not do so in an absolutist fashion.¹³

The rise of British imperial rule over this same period—first in Ireland, then in North America—led to further opposition to absolutism, especially in British colonies. Indeed, the ideological opposition to absolutism that had played such a large role in the seventeenth-century English revolutions played a similar role during the American Revolution and the controversies over the Constitution.¹⁴ Largely as a result of that ideological opposition, the Constitution defined the limits of governmental power substantially by the private property rights it could not violate—seizing private property without compensation, or quartering troops in private homes, among other things.¹⁵ Such principles rest upon a belief that private property is a natural thing, so the right to private property is an inalienable right.¹⁶

Water rights are private property rights in the English legal tradition.¹⁷ American law continued this tradition, since Locke's theory of property, so radical in the seventeenth century, had become orthodox by the turn of the

10. For another review of the 1988 and 2002 China Water Law, *see id.* at 259-64, 273-99.

11. DEREK HIRST, *AUTHORITY AND CONFLICT: ENGLAND, 1603-1658*, at 27, 112, 225 (1986).

12. J.R. JONES, *COUNTY AND COURT: ENGLAND, 1658-1714*, at 234-55 (1978).

13. W.A. SPECK, *RELUCTANT REVOLUTIONARIES: ENGLISHMEN AND THE REVOLUTION OF 1688*, at 241-51 (1988).

14. BERNARD BAILYN, *THE IDEOLOGICAL ORIGINS OF THE AMERICAN REVOLUTION* (1967); *see, e.g.*, *THE DECLARATION OF INDEPENDENCE* paras. 2, 22 (U.S. 1776) (opposing "absolute Despotism" and the establishment of an "arbitrary Government"); U.S. CONST. art. I, § 9, cl. 3 (prohibiting legislative absolutism in the form of Bills of Attainder).

15. U.S. CONST. amends. V, III.

16. *See* JOHN LOCKE, *TWO TREATISES OF GOVERNMENT* 294-97 (Peter Laslett ed., Cambridge Univ. Press 1988) (1690).

17. *See generally* JOSHUA GETZLER, *A HISTORY OF WATER RIGHTS AT COMMON LAW* (2004) (summarizing Blackstone's view that a water right is an individual property right and that private actions were available to defend the right).

nineteenth century. According to Locke, apply industry to wilderness, and prove up property.¹⁸ By 1848, the United States had obtained legal title to the American West; yet to settle it, the United States relied upon grants of these millions of acres of land and acre-feet of water rights of previously public property to private entities and persons. Such reliance on the private sector contrasts starkly with the history of land and water development in China. Rather than build railroads, it granted lands to railroad corporations. Rather than finance the sale of virgin farm and range lands, it passed a series of homestead and range acts that allowed private persons to obtain legal title to real estate in exchange for their work. And in the realm of water rights, this method reached a logical extreme. Rather than generating its own law on water rights, state courts and state legislatures instead recognized a local custom that was already in place—the “law of the camps,” prior appropriation.¹⁹

In the driest parts of the West, however, the climate and the soil began to falsify Locke’s theory of property. West of central Kansas, farmers and ranchers needed more than 160 acres to survive, because lower precipitation produced unsustainably low yields. Private enterprises such as irrigation companies often lacked the capital and the leverage to build the necessary diversion works from distant sources. In the drier parts of the West, industry alone could not transform wilderness into property.

In responding to this hydrological reality, the United States entered its imperial phase with water.²⁰ From the Reclamation Act of 1902 forward, the federal government financed, built, and controlled the water projects that attempted the full development of the West and the exploitation of its natural resources.²¹ The Bureau of Reclamation either built or essentially subsidized the construction of irrigation projects such as the Bostwick Irrigation Districts of Nebraska and Kansas; of reservoir storage and hydropower projects such as the Grand Coulee and Boulder Dams on the Colorado River; of interstate water reservoirs such as Elephant Butte Reservoir in New Mexico (on the Rio Grande) and John Martin Reservoir in Colorado (on the Arkansas River); and of massive diversion works such as the Central Arizona Project. The words embossed into Hoover Dam revealed this new, imperial, concrete presence:

18. See LOCKE, *supra* note 16. Locke’s theory of property was implicitly recognized in several nineteenth century common law cases. See, e.g., *Pierson v. Post*, 3 Cai. 175 (N.Y. Sup. Ct. 1805); *Acton v. Blundell*, 152 Eng. Rep. 1223 (1843).

19. See, e.g., *Morton v. Solambo Copper Mining Co.*, 26 Cal. 527 (1864); *Irwin v. Phillips*, 5 Cal. 140 (1855); *Coffin v. Left Hand Ditch Co.*, 6 Colo. 443 (1882). See also STEPHEN J. FIELD, *PERSONAL REMINISCENCES OF EARLY DAYS IN CALIFORNIA WITH OTHER SKETCHES* 73 (The Legal Classics Library 1989); JOHN D. LESHY, *THE MINING LAW: A STUDY IN PERPETUAL MOTION* 13 (1987).

20. For a sustained treatment of the imperial dimension to western water development, see DONALD WORSTER, *RIVERS OF EMPIRE: WATER, ARIDITY, AND THE GROWTH OF THE AMERICAN WEST* (Pantheon Books 1985). See also K.A. Wittfogel, *Developmental Aspects of Hydraulic Societies*, in *IRRIGATION CIVILIZATIONS: A COMPARATIVE STUDY* 43 (J.H. Steward, ed., Pan-American Union 1955).

21. See, e.g., 43 U.S.C. § 371 (2000).

“Kaiser Permanente.” (Or, no less humbly, the Imperial Irrigation District of the Imperial Valley of California.)²²

By 1960 or so, China and the American West seemed to have little in common, other than their dry hinterlands and their patriotism. In the western United States, property rights in water predate systematic, large scale water development, while the reverse is true in China. In China, empire and centralized rule preceded the establishment of property rights in water; in the American West, private water rights and state water law preceded massive federal water supply projects. Their construction required a federalist compromise with long-established (at least in American terms) water rights and water-management regimes that were based in state, not federal, law.²³ Such a compromise has not been necessary in China.

Nonetheless, from these fundamentally different origins, water management in both the Basin and the American West began to converge during the late twentieth century. The first convergence regards water infrastructure and its politics: in both Communist China and Cold War America, national governments embarked upon massive water-control and water-supply projects, establishing an unprecedented national and federal presence in distant areas.²⁴ Such large-scale water development assured these arid regions of much greater and more dependable water supplies, thus attracting unprecedented economic and demographic growth. The second convergence regards water-diversion technology: the development of large-scale groundwater irrigation during the 1960's and 1970's brought higher yields and new development, but created serious problems such as the impairment of surface water flows, land subsidence, and salinization.²⁵ These two convergences led to the third and most important convergence: water shortage from overuse and overappropriation. Reservoirs brought population and development, which increased pressures on water supplies, at the same time that increased groundwater pumping was depleting flows to those reservoirs, lowering their levels. Across the world, water experts began to discern a common pattern of groundwater overuse and its consequences—the “rise and fall of groundwater socio-ecologies.”²⁶

Whether the causes of these convergences are more similar than different is, as usual, a matter of scholarly debate. This article begins with the presumption that these convergences provide an opportunity to examine how the different water management policies and water laws of the Basin and of Kansas have addressed, and can address, common problems. The pressure of massive reservoirs can literally cause earthquakes, whether at Hoover Dam or

22. See MARC REISNER, *CADILLAC DESERT: THE AMERICAN WEST & ITS DISAPPEARING WATER* (1986) (providing a comprehensive and critical examination of the reclamation program).

23. See, e.g., *Arizona v. California*, 373 U.S. 546 (1963); *Hinderlider v. La Plata River & Cherry Creek Ditch Co.*, 304 U.S. 92 (1938).

24. See generally Wittfogel, *supra* note 20; WORSTER, *supra* note 20.

25. See generally Tushaar Shah, *The Groundwater Economy of South Asia: An Assessment of Size, Significance, and Socio-Ecological Impacts*, 15 KAN. J.L. & PUB. POL'Y 407 (2006).

26. *Id.* at 428.

at Three Gorges.²⁷ Impending groundwater crises may unfold more slowly, but their long-term effects may prove to be more dangerous. Against that challenge, comparing the successes and failures of water management in the Basin and in Kansas may lead to useful conclusions.

III. Common Water-Supply Problems in the Yellow River Basin and Kansas

Western Kansas and the northwest part of the Basin share many geo-hydrological conditions and economic characteristics. Both pursue large-scale irrigated agriculture in arid and semi-arid regions, with an emphasis on wheat and corn production, as well as expanding dairy and meat industries. However, the over-exploitation of groundwater has led to dry-up problems, both on the Yellow River and on the Kansas portion of the upper Arkansas River. Both places have already undergone water rights transfers from irrigation to municipal and industrial use. These types of transfers may become more prevalent as cities and industries, including coal-fired power plants, have increased water demand.

A. The Yellow River Basin

1. In General

Besides persistent and serious flood and sediment problems, the Yellow River is one of the great rivers of the world facing extreme water stress and dry-up problems.²⁸ These problems result from the vast increase in the area of irrigated land in the Basin, which has produced a large disparity between water demand and water supply. In the 1950's, the irrigated area in the Basin was 800,000 hectares ("ha"); by 2000, that figure had reached 7.53 million ha. The Lower Reach of the Yellow River's main stem ran dry at least part of the time during twenty-one of the twenty-seven years between 1972 to 1998, for a total of 1,050 days, or roughly fifty days a year. In the worst year, 1997, it was dry for 221 days, along more than 700 km of the main stem.²⁹ The dry-up problem occurred earlier in the year and more frequently as well on the five large tributaries of the Yellow River—the Wei, Fen, Yiluo, Qin and Dawen Rivers. The Qin River first dried up in 1962, and has dried up almost every year since 1965. In 1991, it dried up for 287 days.³⁰

27. Gautam Naik & Shai Oster, *Scientists Link China's Dam to Earthquake, Renewing Debate*, WALL ST. J., Feb. 7, 2009, at A6.

28. See, e.g., Geoffrey Lean, *Death of the World's Rivers*, THE INDEP. (London), Mar. 12, 2006, available at <http://www.independent.co.uk/environment/death-of-the-worlds-rivers-469597.html>.

29. Li Guoying, *Thoughts and Considerations on Long-term Yellow River Development and Management*, JOURNAL OF YELLOW RIVER (assessed in Dec. 2002) (P.R.C.), available at www.yellowriver.gov.cn.

30. An Xindai, *Current Status of Management and Regulation of Yellow River Water Resources and Future Prospect*, 13 J. CHINA WATER RES. 16-19 (2007) (P.R.C.).

Groundwater overuse and salinity are also serious problems in the Basin. By 2000, long-term overuse had reduced groundwater supplies there by an estimated 1,120 million cubic meters, causing sixty-five cones of depression in the Basin, across an area of 6,000 square kilometers (km²). The overdraft of groundwater is most serious in the Shanxi and Shaanxi provinces, which have suffered thirty-four and eighteen groundwater depression cones, respectively.³¹ Overdrafting also causes land subsidence. From 1959 to 1989, 200 km² in the area surrounding Xi'an, the capital city of Shaanxi Province, had subsided due to overdrafting by as much as 1.8 meters—nearly six feet. Similarly, over 250 km² surrounding Taiyuan, the capital city of Shanxi Province, has subsided by as much as 2.6 meters.³²

Integrated management and regulation of surface and groundwater supplies in the Basin have prevented the dry-up of the River's main stem since 1999, but increasing conflicts between water demand and water supply, and their corresponding environmental issues, have not been resolved.³³ This is true especially in the Nixia Hui National Autonomous Region (NXAR) and the Inner-Mongolia Autonomous Regions (IMAR), which are located in the northwest part of the Basin. Excessive diversions from the Yellow River for irrigation, and the lack of both groundwater management and proper drainage systems, have caused serious salinity problems in as much as 46% of the land in the irrigation areas.³⁴ Overexploitation of groundwater supplies has caused cones of depression in the cities of Yinchuan, Shizuishan, Baotou, and Hohot, and the distance to groundwater in these cities has deepened from an average of 12.7 m to 40 m.³⁵ Due to the growth of inefficient irrigation in the large arid land area along the edge of the desert, and due to the rapid increase in urban and industrial groundwater withdrawals, both the NXAR and the IMAR have exceeded the water quotas allocated to them by the central government. Even after 1999, these withdrawals have nearly run the River dry during the irrigation season.³⁶

In 2002 the Yellow River Conservancy Commission (YRCC), for the first time, suspended the issuance of new water permits in the region, to force these regions to improve irrigation efficiency and to ensure streamflows.³⁷ Inspired

31. YELLOW RIVER CONSERVANCY COMM'N, THE YELLOW RIVER WATER RESOURCES AND MANAGEMENT AND REGULATION 51-52 (Yellow River Conservancy Press 2006) (P.R.C.) (on file with the author Xue Yunpeng) [hereinafter YRCC, YELLOW RIVER WATER RESOURCES].

32. LIN XUEYU ET AL., STUDY ON THE GROUNDWATER RESOURCES IN THE YELLOW RIVER BASIN AND ITS RENEWABLE CAPACITY 148-49 (Yellow River Conservancy Press 2006) (P.R.C.).

33. SU MAOLIN, PRELIMINARY ASSESSMENT OF THE IMPACTS OF THE UNIFIED WATER ALLOCATION AND REGULATION IN THE YELLOW RIVER, PROCEEDING OF THE 2ND INTERNATIONAL YELLOW RIVER FORUM 202-09 (Shang Hongqi ed., Yellow River Conservancy Press, vol. 4 2005) (P.R.C.).

34. Sun Xuetao, *Some Issues on Water-saving and High-efficiency Farming of China*, 4 J. CHINA ENG'G SCI. 24, 24-30 (2002) (P.R.C.), available at <http://scholar.ilib.cn/A-zggckx200209005.html>.

35. XUEYU ET AL., *supra* note 32, at 148-49.

36. YRCC, YELLOW RIVER WATER RESOURCES, *supra* note 31, at 122-23.

37. YELLOW RIVER CONSERVANCY COMM'N, DESIGN AND PRACTICE IN WATER RIGHT

by the practice of water rights exchanges in the United States and Australia, the YRCC and the Basin's provincial governments began to conduct water rights transfer experiments, to provide water supplies for the burgeoning coal-based industry in the region. Chinese water experts continue to investigate an integrated surface and groundwater management program, in an attempt to provide both sustainable water development and environmental protection.³⁸

2. The Particular Problems of IMAR and NXAR

Located in the northwest area of the Yellow River Basin and surrounded by deserts and mountains, the irrigation districts of the IMAR and the NXAR rank as the second and third largest agricultural water consumers in the Basin.³⁹ The average annual precipitation in these regions is low—180-400 mm and 130-400 mm respectively, while the average annual evaporation is high—1,100-1,600 mm and 1,845-2,389 mm, respectively.⁴⁰

Like the Lower Nile River in Egypt, irrigation is critical for agriculture in the Basin. Irrigation with Yellow River water started in these regions 2000 years ago, and it expanded greatly in the 1960s, when the Qingtongxia and Sanshenggong Dams were constructed. Due to low design standards and lack of funds for construction and maintenance, most of the irrigation canals are not lined, and the drainage systems are incomplete, with corresponding low efficiency in these two regions.⁴¹ After over thirty years' operation without proper maintenance, the actual irrigation area has decreased to 435,400 ha in the NXAR and 762,400 ha in the IMAR, while the water use efficiency of these canal systems ranges between 0.38 to 0.45 and 0.35 to 0.51, respectively.⁴² In other words, between 50-60% of Yellow River water is lost

TRANSFER MANAGEMENT SYSTEM CONSTRUCTION 32-38 (Yellow River Conservancy Press 2008) (P.R.C.) [hereinafter YRCC, DESIGN AND PRACTICE].

38. Xindai, *supra* note 30, at 16-19.

39. See YRCC, YELLOW RIVER WATER RESOURCES, *supra* note 31, at 116. The table of average yearly surface water consumption of different sectors of the Yellow River from 1988-2008 shows agricultural water use accounts for 90.7% of the total surface water consumption of the Basin, while the agricultural water use in NXAR and IMAR accounts for over 97% of the total surface water use. *Id.* Shandong Province in the Lower Reach and IMAR always rank first and second largest water users in both total consumption and agricultural sector, respectively. *Id.* However, NXAR surpassed Henan Province in the Lower Reach and became the third largest water consumer in the case of total consumption after 1988 but always ranks third in the case of the agricultural sector. *Id.*

40. See Fen Ping et al., *The Hydrological Characteristics of the Ningxia Hui Autonomous Region*, 21 J. HYDROLOGY CHINA 53, 53-55 (2001) (P.R.C.); Liu Helin et al., *Impact of the Irrigation Water from the Yellow River on Salinification in Hetao Regions of Inner-Mongolia*, 34 J. ANHUI AGRIC. SCI. CHINA 948, 948-50 (2006) (P.R.C.).

41. THE INST. OF RECONNAISSANCE, PLAN, DESIGN, & RESEARCH OF THE YELLOW RIVER CONSERVANCY COMM'N (IRPDR-YRCC), THE BIOGRAPHY OF THE HYDRAULIC ENGINEERING WORKS OF THE YELLOW RIVER 499-501, 561-67 (Henan People's Press 1996) (P.R.C.).

42. THE HYDROLOGY BUREAU OF NINGXIA (HBNX), THE YELLOW RIVER WATER RIGHT TRANSFER MASTER PLAN OF THE NINGXIA AUTONOMOUS REGION (2005) (P.R.C.); INST. OF HYDRAULIC AND ELEC. RECONNAISSANCE & DESIGN OF INNER MONGOLIA AUTONOMOUS REGION (IHERD-IMAR), THE YELLOW RIVER WATER RIGHT TRANSFER MASTER PLAN OF THE

during the canal transfer process.

Since 1998, the Chinese government has established a national program to rebuild and maintain large irrigation districts, sharing the costs with local governments. In 1999, the governments of NXAR and the IMAR developed their Large Irrigation Districts Water Saving Plan of Year 2015, under the instruction of the central Ministry of Water Resources of China. However, due to lack of funds, especially matching funds from the provincial and local governments, most of the planned projects have not been implemented.⁴³ In the three large irrigation districts of the NXAR and the IMAR, actual investment in these projects is a scant 4-10% of the total plan fund.⁴⁴

There are four major water problems in the Basin: (1) the continuous over-use of surface water, (2) underdevelopment of groundwater resources for irrigation, (3) irrigation-induced salinity, and (4) groundwater over-drafting in cities.

The first major water problem in the Basin is the continuous over-use of surface water from the Yellow River. Due to high demand for irrigation water, and the low efficiency of its irrigation systems, almost every year both the NXAR and the IMAR have diverted and consumed much more surface water from the Yellow River than their allocated yearly quotas allow. Between 1999 and 2005, the average water consumption diverted from the Yellow River in the NXAR and IMAR was 24% and 39% higher than their respective quotas.⁴⁵ During the peak irrigation periods between May and early July, when the Yellow River's flow exceeds 1,000 m³/s, canal diversions in the NXAR and IMAR capture 90% of that flow, leaving just 100 m³/s of streamflow in the downstream Inner Mongolia Reach. Sometimes that flow can fall below the minimum flow alarm threshold of 50 m³/s, nearly running the river dry over the 200 km stretch between the Upper Reach and the Middle Reach of the Yellow River, while also threatening dry-ups on the Middle Reach and Lower

INNER MONGOLIA (2005) (P.R.C.). Both Right Transfer Master Plans have been submitted by the governments of NXAR and the IMAR and ratified and approved by the YRCC.

43. Zhao Zhilian, *The Matching Fund Problems of Irrigation Water Saving Projects of Yellow River Irrigation Districts in Northwest China*, YELLOW RIV. NEWSPAPER, Oct. 12, 2007, available at <http://www.hwcc.com.cn/newsdisplay/newsdisplay.asp?Id=181383>. An investigation of 255 large Irrigation Districts of China in 2005 showed that on average only 7% of the planned matching funds for key irrigation water saving projects owed by the provincial and local governments have actually been funded. As to farmland level projects, the actual funded rate is 4%; the situation is even worse for the Yellow River Irrigation Districts in the northwest area of China. *Id.*

44. See YRCC, DESIGN AND PRACTICE, *supra* note 38, at 178 (stating the plan for the water saving project fund for the three large irrigation districts is 14.384 billion RMB, but the actual fund invested is only 1.364 billion RMB).

45. See YELLOW RIVER CONSERVANCY COMM'N, YELLOW RIVER WATER RESOURCES BULLETIN: 1999-2005 (P.R.C.). The average actual consumption of the Yellow River water in the NXAR from 1999 to 2005 was 3,819 million cubic meters, which was 728 million cubic meters or 24% higher than the average yearly water quota. *Id.* Similarly, the actual consumption of the Yellow River water in the IMAR from the Yellow River was 1,386 million cubic meters or 38.6% higher than its allocated quota. *Id.*

Reach.⁴⁶

The second major water problem in the Basin is underdevelopment of groundwater resources in irrigation areas. The sustainable yield of groundwater supplies in the NXAR and IMAR is estimated to be 1,695 and 4,441 million cubic meters, respectively.⁴⁷ However, according to the Yellow River Water Resources Bulletins from 1999 to 2005, the actual average annual groundwater consumption in these regions was only 288 and 1,896 million cubic meters per year between 1999 and 2005, which accounts for only 17% and 43% of their respective estimated renewable groundwater resources.

The third major water problem in the Basin is irrigation-induced salinity. Since the irrigation systems in NXAR and IMAR consist mostly of unlined earthen canals with poor drainage systems,⁴⁸ their inefficiencies have lost a high amount of water through seepage and evaporation, while greatly increasing the salinity of the irrigated soils. For example, there are about 133,000 ha of saline land in the Qingtongxia Irrigation District of the NXAR, and about 333,000 ha in the Hetao Irrigation District of the IMAR. In other words, between 40-62% of the total irrigated area of these two irrigation districts is officially classified as saline.⁴⁹

The fourth major water problem in the Basin is groundwater overpumping in the regions' large cities. In contrast to the high water tables in rural irrigated areas, the water tables in large cities such as Yinchuan, Baotou, and Hohhot in the NXAR and the IMAR are dropping rapidly and continuously, due to the overpumping of confined groundwater for domestic and industrial use.⁵⁰ In Yinchuan City, the capital of the NXAR, the area of groundwater cones of depression has increased from 262 km² in 1995 to 470 km² in 2003. Similarly, the water table has been lowered by between 30 and 150 meters over the last thirty years. Overpumping has also caused the previously confined aquifer to mix with the shallow water table, polluting the aquifer.⁵¹

B. Kansas

The state of Kansas lies on the boundary between the humid East and the semi-arid West. Annual rainfall decreases from eastern to western Kansas from a high of 101 cm in the southeast to a low of 40 cm in the northwest. In 2002, the average farm size was 296.6 ha. Approximately 14.7% of farmland

46. YRCC, *YELLOW RIVER WATER RESOURCES*, *supra* note 31, at 122-23.

47. See Zhang Xuecheng & Pan Qimin, *THE ASSESSMENT OF THE YELLOW RIVER WATER RESOURCES* 131 (Yellow River Conservancy Publishing House 2006).

48. YRCC, *DESIGN AND PRACTICE*, *supra* note 37, at 121, 245 (clarifying only 16.3% of the total length of the canal system of Qingtongxia Irrigation District in NXAR is lined and only 4.43% of the Hetao Irrigation District is lined).

49. Xuetao, *supra* note 34, at 24-30.

50. XUEYU ET AL., *supra* note 32, at 148-49.

51. Xue Saiguang & Fang Shuxing, *The Water Resources Development and Environmental Problems in Nixia Irrigation Area*, in *PROCEEDING OF THE HIGH LEVEL SYMPOSIUM ON THE WATER RESOURCES PROBLEM OF NORTHWEST CHINA AND COUNTERMEASURES* 328-335 (Jiao Yong, ed., Xinhua Press 2006).

of the state is irrigated, while in the semi-arid west and southwest parts of Kansas, irrigated farmland accounts for 36.7% and 53.5% of farmland, respectively. Almost all of the irrigation in these parts of Kansas is from groundwater, using the center pivot irrigation system.⁵² Kansas too has its problems with water, and most of them are related to groundwater overdraft: (1) the unsustainable development of groundwater supplies, which has caused a permanent lowering of the water table; (2) the decrease of baseflows and riparian vegetation; (3) the shrinkage of streamflows; and (4) salinity problems.

The first and most important problem in Kansas is the unsustainable development of groundwater, which has caused a permanent lowering of the water table in areas with low or zero recharge. Groundwater pumping between 1950 and 1990 depleted significant portions of the High Plains aquifer, causing water table declines, especially in southwest Kansas. As a result of these declines, the Kansas Department of Agriculture, Division of Water Resources (DWR), has officially closed many areas of western and central Kansas to new groundwater development.

Groundwater pumping has led to the second problem, a decrease of instream baseflow and a reduction in riparian vegetation. Overpumping has dried up or threatened numerous reaches of baseflow-dependent streams,⁵³ wetlands, and subirrigated land (land irrigated naturally with a high water table) in Kansas along the fringes of the High Plains aquifer. As a result of these groundwater level declines, streamflows of western and central Kansas have been decreasing, especially since the mid-1970s. Riparian vegetation has suffered the worst of these declines in western and central Kansas, with numerous dead cottonwood and poplar trees visible across the countryside.⁵⁴

The third problem in Kansas concerns the shrinkage of streamflows in watersheds that are hydrologically connected to groundwater supplies. In response to these streamflow declines, the Kansas Legislature passed a series of minimum desirable streamflow (MDS) statutes in 1984, which attempt to maintain streamflows across Kansas.⁵⁵ Although these statutes were an important step toward conservation of surface water supplies and riparian habitat within the state, they have not succeeded in reducing the decades-long trend of declining outflows from streambeds down to the baseflow. This problem continues because the MDS statutes obey the law of prior appropriation: although water rights issued subsequent to the MDS statutes are subject to their requirements, water rights existing before the MDS take priority over MDS, and are thus unaffected by the MDS limits.⁵⁶ Maps

52. John C. Peck, *Groundwater Management in Kansas: A Brief History and Assessment*, 15 KAN. J.L. & PUB. POL'Y 441, 460 (2006).

53. "Baseflow" is the term used to describe the movement of alluvial groundwater.

54. M.A. Sophocleous, *From Safe Yield to Sustainable Development of Water Resources: The Kansas Experience*, 235 J. HYDROLOGY 27, 38 (2000).

55. KAN. STAT. ANN. §§ 82a-703a, -703b (1997).

56. § 82a-703b.

comparing the perennial streams in Kansas in the 1960s to those of the 1990s show a marked decrease in miles of streamflow in the western third of the state.⁵⁷

The fourth problem consists of increases in soil and water salinity, which have resulted from groundwater irrigation. Increases in groundwater use leave behind salts in the soil, which dissolve in irrigated flows. Saline water from irrigation return flows in the Upper Arkansas River basin now threaten the groundwater resources of the alluvial and Ogallala aquifers in Kansas.⁵⁸ The Kansas Geological Survey has embarked on a multi-year study to analyze the impact of Arkansas River salinity on these aquifers, salinity that results from irrigation return flows in both Colorado and Kansas.

IV. WATER LAW AND WATER MANAGEMENT IN THE YELLOW RIVER BASIN AND IN KANSAS

A. *China*

China's water management system is part and parcel of China's centralized political system. While every provincial government may have its specified water law and management policies, each must obey the principles of national water law and policy.

Before 2002, China exercised a system of unified administration of water resources, in association with several departments at each level of government.⁵⁹ Under the new Water Law of 2002, the Ministry of Water Resources (MWR) became responsible for the overall water management of China, including surface water and groundwater. The MWR cooperates with the related regional and local departments, based on the concept of integrated water resources management.⁶⁰ For example, while the Ministry of Environmental Protection (MEP, known as the State Environment Protection Administration before 2007) oversees water pollution control including water quality monitoring, the MWR is also responsible for monitoring water quality.⁶¹

At the regional level and local levels, China has adopted a combination of water management systems. The first regional management system is based on

57. Sophocleous, *supra* note 54, at 29.

58. D.O. Whittemore et al., *The Upper Arkansas River Corridor Study: An Update*, HYDROGRAM, Spring 1999, at 17.

59. Water Law (promulgated by the Order No. 61 of the President of the Nat'l People's Cong. on Jan. 21, 1988, effective July 1, 1988), art. 9 [hereinafter 1988 Water Law].

60. Water Law (promulgated by Order No. 74 of the President of the Nat'l People's Cong. on Aug. 29, 2002, effective Oct. 1, 2002) arts. 2, 12 & 13, available at <http://www.china.org.cn/english/government/207454.htm> [hereinafter 2002 Water Law].

61. *Id.*, art. 81; Law on Prevention and Control of Water Pollution (promulgated by the Standing Comm. Nat'l People's Cong., May 11, 1984, amended by the Standing Comm. Nat'l People's Cong., May 15, 1996, and amended by the Standing Comm. Nat'l People's Cong., Feb. 28, 2008, effective June 1, 2008), available at <http://www.chinaenvironmentallaw.com/wp-content/uploads/2008/03/water-pollution-prevention-and-control-law.pdf>.

the river basin's hydrology, while the second is based on the political-administrative units of China's government. The MWR established basin commissions for each of the seven major river basins in China, to conduct basin-wide water management, mainly of large, trans-provincial rivers or lakes on behalf of the MWR.⁶² At the local level, the departments of water resources at the provincial, prefecture (city), and county levels of government are responsible for overall water management under their corresponding administrative jurisdictions and under the cooperation of the same level government departments.⁶³

Chinese water management is undergoing transition and reform in an effort to coordinate surface and groundwater management as well as urban and rural water management. Ultimately, this reform seeks to integrate all water-related administrative responsibilities into one unique water agency, in charge of unified surface water and groundwater management both in rural and urban regions, in order to improve the capacity to enhance integrated water resources management. Such a bureau has been established in Shenzhen City, a special economic zone. The need for such a bureau is demonstrated by the sheer number of local governments in China, where there are 1,359 local governments at the provincial (e.g. Beijing, Shanghai, Henan, Shanxi), prefectural (e.g. Xi'an, Baotou, Zhengzhou), and county levels. To coordinate and integrate such a multiplicity of water administration, Chinese authorities have been working to merge all water administration-related water responsibilities into a unique water administration department.⁶⁴ At the same time, the China Geological Survey (CGS), under the Ministry of Land and Natural Resources (MLNR), formerly the Ministry of Geology and Mineral Sources (MGMR), is still playing an important role in groundwater monitoring and technical management. The CGS advises MWR on the groundwater planning and groundwater permit management, although it no longer issues groundwater permits on behalf of MWR.⁶⁵ However, there is a large discrepancy among estimates of available groundwater in the Basin. In 1998, experts from the MLNR estimated those supplies to be 44.665 billion cubic meters (BCM), or 36.2 million acre-feet, while the MGMR estimated them to be 45.178 BCM (36.6 million acre-feet), and the YRCC estimated them to be 40.5 BCM (32.8 million acre-feet).⁶⁶

B. Kansas

In the United States, administrative agencies involved with water issues exist at all levels of government: federal agencies, state agencies, interstate

62. 2002 Water Law, *supra* note 60, art. 12.

63. *Id.* at arts. 12-13.

64. See Weigui Liang et al., *The Challenges and Countermeasures in the Unified Water Affairs Administration*, 10 J. WATER ARENA 12, 12-14 (2006) (P.R.C.).

65. Regulation on Administration of Water Permit and Water Resource Fees (2006), art. 7 (on file with author Xue Yunpeng) [*hereinafter* Regulation of Water Permits].

66. XUEYU ET AL., *supra* note 32, at 148-49.

water commissions, special water districts, and municipalities. These agencies have reasonably well-defined responsibilities and jurisdictions, although the responsibilities occasionally overlap. At the national level, the U.S. Army Corps of Engineers and the Bureau of Reclamation of the Department of Interior are responsible for management of federal dams in the east and the west, respectively.⁶⁷ The U.S. Environmental Protection Agency (EPA) is responsible for water pollution matters.

In the state of Kansas, DWR is responsible for water quantity—water allocation and water rights management. Along with EPA, the Kansas Department of Health and Environment (KDHE) is responsible for water quality, enforcing state water quality standards, environmental laws relating to water, and other regulations. The Kansas Water Office (KWO) formulates a state water plan, and contracts with local water users for water supply from federal reservoirs.⁶⁸ The Kansas Water Authority (“KWA”), which consists of representatives from water user groups, heads of the water-related departments of Kansas, and water experts appointed by the governor of Kansas, also formulates state water plans.⁶⁹ The KWA meets periodically to discuss and approve long-term water planning concepts and the annual Kansas Water Plan drafted by the KWO. The Water Plan is then submitted to the legislature for consideration and possible approval and implementation.

To further enhance institutional coordination and efficiency, former Governor Kathleen Sebelius formed a sub-cabinet team consisting of her energy advisor, Joe Harkins, and the heads of six water-related agencies—the Department of Agriculture (KDA), Department of Wildlife and Parks (DWP), KDHE, the State Conservation Commission (SCC), DWR, and the KWO. The team meets two to three hours every week, to discuss and to implement sophisticated techniques and holistic approaches to agriculture, energy, water development, and environmental protection. The sub-cabinet team attempts to cooperate in applying a coherent approach to dealing with complicated relationships involving water, such as competing policy demands for water supplies among different agencies.

In response to the groundwater depletion problem, Kansas established five Groundwater Management Districts (“GMDs”) in central and western Kansas in the 1970s. The purpose of the GMD Act, passed in 1972, was “to establish the right of local water users to determine their destiny with respect to the use of groundwater insofar as it does not conflict with the basic law and policies of the state of Kansas.”⁷⁰ The staff and the boards of Kansas GMDs assist the Chief Engineer in developing and administering groundwater policy within the boundaries of each GMD. Those policies vary with the GMD:

67. This is a generalization: the Corps and the Bureau cooperate in managing the water supplies of federal reservoirs. The Bureau of Reclamation acts as the federal contracting agent for irrigation water supplies stored in Corps reservoirs.

68. KAN. STAT. ANN. § 74-2608 (2002).

69. § 74-2622 (Supp 2008).

70. § 82a-1020 (1997).

GMD2 and GMD5, whose groundwater supplies are rechargeable, have policies of zero depletion of groundwater, while GMD3, which overlays the fossil water of the Ogallala, has a policy of planned depletion.⁷¹

The Chief Engineer of DWR also has the power to establish Intensive Groundwater Use Control Areas (IGUCAs).⁷² To establish an IGUCA, the Chief Engineer must find that the hydrological conditions require it: that groundwater levels are declining or have declined excessively; or that the rate of groundwater withdrawals exceeds the rate of recharge; or that preventable waste of water is taking place; or that water quality is deteriorating; or that other conditions exist that require regulation in the public interest.⁷³ Although a main purpose of the GMD Act is to foster cooperation between the local GMD board and the Chief Engineer, the Act endows the Chief Engineer with clear statutory power to impose an IGUCA by his own initiative.⁷⁴ As part of that power, the statute empowers the Chief Engineer to reduce the annual pumping of water rights holders, regardless of the priority date of a particular water right.⁷⁵

However, the Chief Engineer's statutory power to reduce such water rights in an IGUCA raises potential legal conflicts between individual property rights and the powers of the state. The constitutionality of this power has been questioned.⁷⁶ Under the Fifth Amendment of the U.S. Constitution, property rights are protected against "takings" by the government without compensation. Water rights are defined as real property rights.⁷⁷ Thus, the forced reduction of annual pumping of senior water rights by the Chief Engineer is arguably a "taking." This issue has not been resolved, however, by the Kansas Supreme Court. In other states, a slow evolution and transformation of the fundamental concept of how water rights are viewed is underway. States are empowered to cut back on pumping if "waste" is occurring.⁷⁸ In California, the Public Trust Doctrine has been employed to empower the state agency to reduce surface water rights;⁷⁹ in North Dakota, it has been employed to prevent the issuance of new groundwater appropriations and to impose water planning in groundwater.⁸⁰

71. Kan. Admin. Regs. § 5-23-4 (2003).

72. KAN. STAT. ANN. §§ 82a-1036 (1997), 82a-1038 (Supp. 2008).

73. § 82a-1036(a)-(e).

74. Kan. Atty. Gen. Ops. 2002-24, 2007-32.

75. KAN. STAT. ANN. § 82a-1038(b) (Supp. 2008).

76. See John C. Peck, *Property Rights in Groundwater—Some Lessons from Kansas Experience*, 12 KAN. J.L. & PUB. POL'Y 493 (2003); Kan. Atty. Gen. Op. 1988-6 (considering whether the chief engineer's reduction of a groundwater right amounts to a compensable taking under the Fifth Amendment depends upon the purpose of the taking).

77. § 82a-701(g) (Supp. 2008).

78. *Imperial Irrigation Dist. v. State Water Res. Control Bd.*, 275 Cal. Rptr. 250 (Cal. Ct. App. 1990).

79. *Nat'l Audubon Soc'y v. Super. Ct. of Alpine County*, 658 P.2d 709 (1983).

80. For North Dakota, see *United Plainsmen Ass'n v. N.D. State Water Conservation Comm'n*, 247 N.W.2d 457 (1976). Idaho is the only other prior appropriation state to voice judicial support for the Public Trust Doctrine, albeit only in dicta. See *Idaho Conservation*

C. Differences in Water Management Principles between the Yellow River Basin and Kansas

In the Basin, the national, basin, and local level water departments coordinate both surface water and groundwater management, including water planning, water and soil conservation, flood control, water monitoring, water allocation, as well as water engineering works construction and management. Nonetheless, the national government is the sovereign power among this coordination.⁸¹ In the United States, the federal government is generally not involved directly with groundwater management. The U.S. Constitution gives only limited powers to the federal government, derived mainly from constitutional clauses dealing with interstate commerce, federal government property, treaty powers, national defense, and health and welfare. And, because private water rights are property rights, they fall under state law jurisdiction. In terms of water-supply infrastructure, the Corps of Engineers and the Bureau of Reclamation construct, maintain, and operate large reservoirs, but state governments generally act as the mediator between federal supply and local water use.⁸²

In China, trans-boundary water disputes between different administrative areas are resolved through negotiation among the relevant agencies. If negotiation fails, the dispute then becomes subject to arbitration or mediation by a higher government agency with jurisdiction over both agencies.⁸³ Administrative orders are enforced by administrative punishments such as warnings, demerits, gross demerits, demotions, dismissals, and expulsions of leaders who disobey orders or commit fault.⁸⁴ As a practical fact, however, neither the YRCC nor even the MWR has enough effective administrative power or economic leverage to prevent the provinces from using more water than their allocated quotas. Only the State Council has the power to punish the provincial governor and other high officials, and this power is seldom exercised. Although the Yellow River Water Regulation Act of 2006 provides punishments for the provincial leader who fails to conduct unified water allocation, the Act contains no such provision for sanctions against the lawbreaker province or compensation to the harmed provinces.⁸⁵ Thus, there is

League, Inc. v. State (Idaho 1995); *Shokal v. Dunn*, 707 P.2d 441 (Idaho 1985). However, these decisions led the Idaho legislature to repudiate the doctrine and any possible application of it to the appropriation of water, use of water, or anything related to water rights in Idaho. IDAHO CODE ANN. § 58-1203 (1996).

81. 2002 Water Law, *supra* note 60, arts. 2, 12, 13, 17, 42, 44, & 46.

82. This is a principal role of the Kansas Water Office. KAN. STAT. ANN. §§ 74-2608, 74-2609 (2008).

83. 2002 Water Law, *supra* note 60, art. 56.

84. The Civil Servant Law (promulgated by Order No. 35 by the President of the Nat'l People's Cong., April 27, 2005, effective Jan. 1, 2006), arts. 55-56, *available at* <http://www.asianlii.org/cn/legis/cen/laws/tcs/lotproc462/>.

85. Regulation of Yellow River Water Regulating (promulgated by Decree No. 472 of P.R.C. State Council on July 5, 2006, effective Aug. 1, 2006), arts. 4, 36, *available at* http://www.yrcc.gov.cn/eng/news/200612/t20061228_11259.htm [hereinafter Yellow River Regulation].

little incentive for provincial officials to limit water use to the prescribed allocation. Although the basin water allocation scheme was issued in 1987, the River continued to dry up, and dry-up problems became even worse in the 1990s. Even after unified water allocation became the administrative norm in 1999, water abstraction quotas were still being exceeded in some regions.⁸⁶

China's attempt to achieve compliance with its provincial water allocations reveals one of the fundamental differences between water administration there and in the United States. Without a legal tradition of property rights in water, and a corresponding right to defend those rights, the government has chosen personal sanctions against government officials as an enforcement mechanism. Under the Yellow River Water Regulation Act as issued by the China State Council, culpable leaders and staff can receive administrative sanctions and can even be subject to criminal prosecution if the offenses are sufficiently severe.⁸⁷ Yet because Chinese society lacks a cultural tradition of conducting administrative management based strictly on following the law, the Act's efficacy remains in question.

The western United States has its share of trans-boundary water disputes. Most of these involve disputes over rivers that flow through more than one state, such as the Arkansas River. Three methods exist to resolve such disputes. The first method is a decree of the U.S. Supreme Court, which allocates the water supply of an interstate stream based on the principle of equitable apportionment.⁸⁸ A second allocation method is Congressional allocation, which has occurred for the Colorado River and perhaps for the Missouri River.⁸⁹ The third method is the interstate compact, a contract between states to allocate interstate waters, which is then approved by Congress. Because of the interstate nature of a compact, the United States Supreme Court exercises original jurisdiction in resolving interstate disputes over water, whether an interstate compact exists or not.⁹⁰

Groundwater management has become a central issue in recent interstate water litigation. One reason for this is that most interstate water compacts

86. See YRCC, YELLOW RIVER WATER RESOURCES, *supra* note 31, at 46-49.

87. Yellow River Regulation, *supra* note 85, art. 36.

88. Colorado v. New Mexico, 459 U.S. 176 (1982); Nebraska v. Wyoming, 325 U.S. 589 (1945); New Jersey v. New York, 283 U.S. 805 (1931); Wyoming v. Colorado, 259 U.S. 419 (1922); Kansas v. Colorado, 206 U.S. 46 (1907).

89. Arizona v. California, 373 U.S. 546 (1963). One may ask whether the Flood Control Act of 1944, 33 U.S.C. § 701-1(b), may arguably have represented a Congressional allocation of the Missouri River. See GEORGE GOULD, ET AL., CASES AND MATERIALS ON WATER LAW 506 n.5 (7th ed. 2005) ("Congressional apportionment of the Missouri River?" The Act adopted the Pick-Sloan Plan that authorized the system of reservoirs ultimately constructed in several states in the basin. In addition, the O'Mahoney-Milliton Amendment granted priority to irrigation interests on federal reservoirs west of the 98th Principal Meridian, while granting priority to navigation interests east of that line.)

90. U.S. CONST. art. III, § 2, cls. 1-2; Judiciary Act of 1789 § 13, 28 U.S.C. § 1251(a). See also Mississippi v. Louisiana, 506 U.S. 73, 77-78 (1992) ("[T]he description of our jurisdiction as 'exclusive' [in 28 U.S.C. § 1251(a)] necessarily denies jurisdiction of such cases to any other federal court.").

were enacted before pumping of groundwater for irrigation on the High Plains was first recognized as a serious problem. *Kansas v. Colorado* involved a series of disputes over Colorado's groundwater pumping in the Arkansas River Basin. Kansas sued Colorado in 1985, and after a lengthy trial before Special Master Arthur L. Littleworth, the Court in 1995 adopted his recommendation that Colorado had violated the Compact by extensive post-Compact groundwater pumping.⁹¹ After nearly twenty years of litigation, Kansas obtained relief in 2004, when the Supreme Court ordered Colorado to pay \$34 million in compensation to Kansas, and to reduce groundwater pumping that was depleting surface flows of the Arkansas River. In 1998, Kansas filed a similar suit against Nebraska to enforce its rights under the Republican River Compact.⁹² In that case, the Court's Special Master ruled that groundwater that contributed to Republican River flows was indeed part of the "virgin water supply" of the Compact.⁹³ The states then settled the case.⁹⁴ Nebraska, however, immediately fell out of compliance with the settlement, largely because it does not regulate groundwater withdrawals in conjunction with surface water flows.⁹⁵ Kansas has resumed legal action to enforce both the settlement and the Republican River Compact.

At least four lessons can be learned from these Kansas cases. The first lesson is purely legal: the Supreme Court has held that alluvial groundwater and groundwater baseflow are included in interstate water compacts that do not mention groundwater.⁹⁶ The second lesson is political. State political leaders—governors, attorneys general, and directors of natural resources—are often tempted to disobey their compact obligations to other states, rather than face the political consequence of making the unpopular decision to reduce their constituents' water use. The third lesson is both legal and political. An interstate water allocation compact limits a State's water use to that established in the compact, regardless of the amount of water rights the state had granted on the river in question prior to the Compact.⁹⁷ Yet where a state does not administer surface water rights and groundwater rights in one legally integrated system of prior appropriation, the political power of groundwater

91. *Kansas v. Colorado*, 514 U.S. 673 (1995). *See also* *Kansas v. Colorado*, 543 U.S. 86 (2004), and John C. Peck, *Groundwater Management in the High Plains Aquifer in the USA: Legal Problems and Innovations*, in *THE AMERICAN AGRICULTURAL GROUNDWATER REVOLUTION* (Mark Giordano & K.G. Villhoth eds., 2007).

92. *Kansas v. Nebraska & Colorado*, 522 U.S. 1073 (1998).

93. *Kansas v. Nebraska & Colorado*, 538 U.S. 720 (2003); *Kansas v. Nebraska & Colorado*, 540 U.S. 964 (2003) (approving Special Master's Final Report certifying adoption of the RRCA groundwater model).

94. *Kansas v. Nebraska & Colorado*, 540 U.S. at n. 91 (2002) (stating the final settlement stipulation).

95. *See, e.g.*, *Spear T Ranch, Inc. v. Knaub*, 691 N.W.2d 116 (Neb. 2005).

96. *See, e.g.*, *Kansas v. Nebraska & Colorado*, No. 126 Orig., Final Settlement Stipulation, Vol. 5, App. J, RRCA Groundwater Model Materials (Dec. 15, 2002); *Kansas v. Nebraska*, No. 105 Orig., Fifth and Final Report of the Special Master, Vol. III, App. C, Hydrological-Institutional Model Documentation and Usable Flow Methodology (Jan. 2008).

97. *Hinderlider v. La Plata River & Cherry Creek Ditch Co.*, 304 U.S. 92 (1938).

interests can frustrate that state's ability to comply with a compact.⁹⁸ Legislative efforts in Nebraska to obtain compact compliance by imposing a local property tax to fund water purchases have recently been found unconstitutional.⁹⁹

The final lesson, one of the oldest chestnuts in western water law, is geographical: it is better to be upstream with a shovel than downstream with a decree. Upstream states have a natural advantage with interstate compacts. Because water allocated to a downstream state flows through the lands of an upstream state, that upstream state can choose to comply or to breach. If the upstream state chooses to breach, it becomes the burden of the downstream state to file suit and prove noncompliance.¹⁰⁰ The downstream state has no choice between compliance and breach; its only recourse is through the compact and its dispute resolution procedures; and even if it prevails in interstate litigation, the upstream state remains upstream, a natural advantage. Substantial political will is required of the downstream state to file a suit that has such uncertain costs, duration, and prospects of a positive outcome.

D. Water Allocation Systems in the Yellow River Basin and Kansas

1. China

In China the water resources are owned by the nation, except the water stored in the ponds of collective units in rural regions, which is owned by the units. The central China State Council holds the water resources rights on behalf of the nation.¹⁰¹ However, the State encourages units and individuals to develop and to use water resources in accordance with law, and the State

98. In Nebraska, surface water is governed by one set of laws that are administered centrally by the state's Department of Natural Resources ("DNR"). NEB. REV. STAT. § 61-206 (2008). However, groundwater is governed by a different set of laws administered by local Natural Resource Districts ("NRDs"). § 46-702. An NRD is a political subdivision of the state of Nebraska. § 2-3213. Each NRD has its own taxing authority. Its board members are popularly elected, and its authority is limited to its discrete geographical area. *See generally* § 2-3201 *et seq.* In fully appropriated areas, the NRDs regulate groundwater use by adopting Integrated Management Plans ("IMPs") with the concurrence of the DNR. § 46-715(1). Because the NRDs "jointly develop" the IMP with the DNR, the NRDs have effective veto control over what limits become effective in the IMP. *Id.* Thus, the state of Nebraska, acting through the DNR, has no supervisory authority over the NRDs concerning groundwater administration. The DNR can obtain such authority but only with the review and concurrence of the Interrelated Water Review Board, a five-person committee appointed by the governor. *See* § 46-719(2)(a). To date, the DNR has not sought such authority.

99. *Garey v. Neb. Dep't of Natural Res.*, 759 N.W.2d 919 (Neb. 2009) (finding localized property tax levied for state purpose of compliance with Republican River Compact in violation of Art. VIII, § 1A of the Nebraska Constitution).

100. In the absence of an interstate compact, when a downstream state is suing for equitable apportionment, the upstream state may defend the action by showing that it obtains a benefit that outweighs the detriment suffered by the under-supplied, downstream state. *Kansas v. Colorado*, 206 U.S. 46, 113-14, 117 (1907); *Nebraska v. Wyoming*, 325 U.S. 589, 619, 622 (1945); *Colorado v. New Mexico*, 459 U.S. 176, 187 (1982); *Colorado v. New Mexico*, 467 U.S. 310 (1984).

101. 2002 Water Law, *supra* note 60, art. 3.

protects their legitimate rights and interests.¹⁰² The State implements systems of water permitting and the paid use of water resources, with the exception that rural collective economic organizations and their members use the water in their own ponds and reservoirs. The department of water administration under the State Council administers water-withdrawal licenses and the paid use of water resources throughout the country.

China introduced a water permit system in 1993,¹⁰³ and in 2006 the China State Council issued regulations on water permits and water resources fee collection.¹⁰⁴ To keep in step with economic reform, the government has established basic principles of water rights and the water permit system, which are still undergoing change and improvement.

Due to the different relationship between property and water rights in China, water allocation and permitting systems in China differ significantly from that of prior appropriation states such as Kansas. Water rights in China are not property rights held by any institution or individual, but are rather licenses, granted by the government in the form of “water abstraction permits.”¹⁰⁵ Every water abstraction permit is a temporary permit with a set time limit, normally of five years, and never over ten years, and these permits automatically expire after the date stipulated on the permit. But the permit can be renewed under a standard process.¹⁰⁶

Water use priority in China depends on the type of water use. Domestic water use has the highest preference, but the order among agricultural, industrial, environmental, and navigation use is not clearly declared under Chinese water law. However, a preference order for a designated water body can be determined by the provincial government as necessary.¹⁰⁷ In the Basin, domestic water use and basic water use for the environment (including sediment flushing and minimum streamflow) have high priority. The Yellow River Water Regulation Act states that “[w]hile the domestic water use in rural and urban areas is the highest priority of water supply, Yellow River water regulating shall also balance the water demand of agriculture, industry and environment so as to prevent the Yellow River from discontinuous flowing.”¹⁰⁸

In the Basin, the Yellow River Conservancy Commission (YRCC) and the provincial and local Department of Water Resources (PDWR) jointly manage

102. *Id.* arts. 6-7.

103. *See* Rules of Implementing the Water Withdrawal Permit System (promulgated by Decree No. 119 of the People’s Republic of China State Council on August 1, 1993), <http://www.chinawater.net.cn/law/W03.htm> (last visited April 15, 2009).

104. *See* Regulation on the Administration of the License for Water Drawing and the Levy of Water Resource Fees (promulgated by Decree No. 460 of the People’s Republic of China State Council on February 21, 2006), http://www.gov.cn/zwggk/2006-03/06/content_220023.htm (last visited April 15, 2009) [hereinafter Regulation for Water Drawing].

105. *See* 2002 Water Law, *supra* note 60, arts. 4, 7.

106. Regulation on Water Drawing, *supra* note 104, art. 25.

107. Regulation of Water Permits, *supra* note 65, art. 5.

108. Yellow River Water Regulation Act (2006), arts. 3, 8 (on file with author Xue Yunpeng).

water permitting.¹⁰⁹ The YRCC issues permits to the largest water users, those whose water abstraction amounts exceed certain limits established by the MWR. For example, the YRCC examines and issues the water permit of a water user whose surface intake capacity for agricultural use exceeds 15 m³/s in the main stem and 8 m³/s in the tributary Wei River, and for groundwater if the user's groundwater abstraction capacity exceeds 20,000 m³ per day.¹¹⁰ Under these withdrawal limits, the PDWR issues water permits within its province or autonomous region.

Groundwater abstraction permits in urban regions can be issued only by the YRCC or the PDWR with prior agreement of the Departments of Urban Construction of the local governments.¹¹¹ Before 2006, the China Geological Survey and Department of Construction had the responsibilities of issuing groundwater permits under the 1993 water permit regulation of China.¹¹²

Under the water abstraction limit and within its time period, a water permit or part of a permit may be sold or leased, provided the original permit issuing organization approves the transfer. This may be done as long as the original water volume to be transferred is maintained by the adoption if necessary of water saving measures by the transferee.¹¹³ However, this kind of practice was not allowed and was subjected to punishment in the water permit regulation of 1993.¹¹⁴

Water management in the Basin controls total water abstraction, and imposes quota-based water use management principles. The safe yield concept is used to evaluate groundwater use permit applications.¹¹⁵ In 1987, the State Council adopted the Yellow River Consumable Water Allocation Scheme, a "total volume control" principle for surface water permit evaluation. Under the Scheme, a water quota for each of the eleven provinces (both autonomous regions and municipalities) along the river was allocated based on the annual average surface water runoff of the River, with water volume reserved for sediment flushing and environmental flows.¹¹⁶

2. Kansas

With the passage of the Kansas Water Appropriation Act ("KWAA")¹¹⁷ in 1945, Kansas adopted the prior appropriation doctrine. Under the KWAA, all

109. See Regulation of Water Permits, *supra* note 65, art. 14.

110. See Ministry of Water Resources of China (MWR), Notice on the administrative responsibility of YRCC in the Yellow River water abstraction permit management, in Water Policy and Resources 197 (1994).

111. See Regulation of Water Permits, *supra* note 65, art. 19.

112. Rules on Implementing the Water Withdrawal Permit System (1993), art. 17 (on file with author Xue Yunpeng).

113. Regulation of Water Permits, *supra* note 65, art. 27.

114. Rules of Implementing the Water Withdrawal Permit System (1993), arts. 26, 28, 30 (on file with author Xue Yunpeng).

115. Regulation of Water Permits, *supra* note 65, arts. 7, 15, 16, 20.

116. YRCC, YELLOW RIVER WATER RESOURCES, *supra* note 31, at 57.

117. KAN. STAT. ANN. §§ 82a-701 *et seq.* (1997 & Supp. 2008).

surface and groundwater within the state is dedicated to the use of Kansans, but is subject to the control of the Chief Engineer, in accordance with the principles of prior appropriation.¹¹⁸ The Chief Engineer controls and regulates that water chiefly through the issuance of permits to appropriate water, permits that become water rights through the process known as perfection, as described below.

As prior appropriation rights, Kansas water rights are governed by the basic principles of priority and appropriation. Regarding priority, “the first in time is the first in right.”¹¹⁹ The Chief Engineer can grant a new water permit only if that right does not impair the existing water rights from the water supply, and if there is sufficient water supply to grant the right.¹²⁰ It is illegal for any person, including a junior water right owner, to prevent water from moving to a person with a senior water right.¹²¹ If the water use of a junior water right owner impairs that of a senior water right owner, then DWR has the statutory duty to enforce the KWAA “in accordance with the rights of priority of appropriation.”¹²² Water rights in Kansas are usufructuary rights. Generally speaking, the owner of a water right must put the water under that right to beneficial use in order to keep the right, unless there is due and sufficient cause for non-use of the water.¹²³

Kansas water rights are real property rights,¹²⁴ and so receive protection from uncompensated takings by the government, under the Fifth Amendment of the U.S. Constitution.¹²⁵ Except for temporary and term permits, water rights are held in perpetuity, as long as the holders meet the conditions associated with them. A water right application ripens into a property interest with the first diversion and use of water after approval of the application, but the applicant still must complete a “perfection period” of typically five years for agricultural use and twenty years for municipal use. The perfection period gives the permit holder time to establish diversion works and pump or divert water, and it gives DWR a chance to inspect the diversion works to insure that the permit holder is meeting the conditions associated with the permit. After the perfection period runs, DWR “certifies” the permit, and the owner files the certificate in the register of deeds in the county where the point of diversion is located. Kansas also has a preference list in the Water Appropriation Act, ordering water uses as follows: domestic, municipal, irrigation, industrial,

118. §§ 82a-702, -706a, -707.

119. § 82a-707(c).

120. § 82a-711(b).

121. § 82a-706b.

122. *Id.*

123. §§ 82a-718(a), (b)(3) (Supp. 2008). The Kansas Supreme Court has stated that this statute is a forfeiture statute (arguably in dicta). *Hawley v. Kan. Dep’t of Agric.*, 132 P.3d 870, 880, 884, 888 (Kan. 2006) (dictum). See also John C. Peck & Constance Crittenden Owen, *Loss of Kansas Water Rights for Non-Use*, 43 U. KAN. L. REV. 801, 823-25 (1995).

124. § 82a-701(g) (Supp. 2008).

125. See James H. Davenport & Craig Bell, *Governmental Interference with the Use of Water: When Do Unconstitutional “Takings” Occur?*, 9 U. DENV. WATER L. REV. 6, 7 (2005) (citations omitted).

recreational, and water power.¹²⁶ But it is not clear what this preference list means, since priority in time governs.¹²⁷

The concept of safe yield was first used as a guideline to control the total permitted withdrawal of groundwater in the two central Kansas GMDs—the Equus Beds GMD No. 2, and the Big Bend GMD No. 5.¹²⁸ DWR employs the concept of safe yield in other parts of Kansas, but in some regions it is too late for safe yield, due to the problem of over-appropriation, and so overpumping remains. This is the dominant problem in Western Kansas GMD No. 1, Southwest Kansas GMD No. 3, and Northwest Kansas GMD No. 4, where the principal source of groundwater is the Ogallala Aquifer, which is effectively not rechargeable. Overappropriation has forced these GMD's to close much of their areas to new appropriations,¹²⁹ and to place extra restrictions on the granting of new appropriations. GMD3 has a nominal policy of "safe yield," but that policy is in truth one of planned depletion, allowing permits if they do not create more than a 40% loss of the aquifer within a two-mile radius circle over twenty-five years.¹³⁰

3. Comments on the Different Water Allocation Systems

If the principles of total volume control for surface water and of sustainable yield for groundwater are adopted and strictly reinforced by a government at the beginning of a water-permitting regime, subsequent problems of over-drafting can be avoided. Unfortunately, this has not been the case in either the Basin or in Kansas.

A short-term water permit system in China gives the water-managing administration great flexibility and power to adjust water allocation policy in the changing natural and social-economic environment. However, a licensing system does put institutions and individuals at risk of losing water permits and associated investments without reasonable compensation from the government.

A progressive water management approach has evolved in Kansas. These include water-management programs, minimum-stream-flow standards, required water use reporting and water metering, the use of modified safe-yield policies in some GMDs, integrated resource planning and development by the City of Wichita, and a subbasin water-resources-management program by DWR, as well as other programs. These are all appropriate steps on the road to sustainable development.¹³¹ The prior appropriation system is a good tool for protecting the water rights of senior holders, and it can reduce depletion, if the

126. § 82a-707(b).

127. § 82a-707(c).

128. KAN. ADMIN. REGS. §§ 5-22-7, -25-4 (2009) (regarding safe yield and sustainable yield, respectively).

129. *See, e.g.*, § 5-23-4b (closing certain townships in GMD No. 3 to new appropriations).

130. §§ 5-23-4, -23-4a(b).

131. KANSAS GEOLOGICAL SURVEY, PERSPECTIVES ON SUSTAINABLE DEVELOPMENT OF WATER RESOURCES IN KANSAS 239 (Marios Sophocleous ed., 1998), available at <http://www.kgs.ku.edu/publications/books/1998/sophocleous>.

administrator has the technical knowledge to know the sustainable yield of a water system and the authority to stop issuing new permits. However, in western Kansas, too many water rights were granted before state officials realized that depletion was taking place and was causing serious problems. Water users with junior water rights, even for important uses, are thus not protected in the long run, unless the Chief Engineer can create a management program that imposes across-the-board reductions in water rights, as in an IGUCA. Given the identity of Kansas water rights as real property rights, if the government were serious about imposing sustainable yield now, it would have to pay a high cost to purchase and retire, or otherwise reduce water rights. Indeed, as Leland A. Rolfs, former counsel to Kansas DWR has written, temporary water rights would make it easier for DWR to make wise decisions on how to allocate water use.¹³²

E. Water Right Transfers as a Management Tool

1. Water Right Transfer Experiments in the Yellow River Basin

Like the United States, the western region of China is rich in natural mineral resources and is a center for the mineral industry; it is also less populated and developed compared to the eastern region, due to its harsh climate and landscape. Under the national government's "National Grand Plan of Developing West," the regions along the Yellow River of NXAR and IMAR will be developed as centers of coal-burning electricity and the production of coal-based chemicals. However, since the two regions have exceeded their corresponding water quotas (due mostly to very low irrigation efficiencies), a serious and deteriorating water shortage problem has developed in the Basin. In response, the YRCC suspended issuing new water abstraction permits to the NXAR and the IMAR in 2002, which closes the door to any new industrial enterprises' obtaining new water permits there.¹³³ Inspired by the successful water market approaches in Australia and the USA, and with the support of MWR the YRCC and the governments of the NXAR and the IMAR, some industrial enterprises reached an agreement in 2003 to conduct water rights transfer experiments.¹³⁴

Water transfers in the Basin encourage industrial enterprises to invest in irrigation water-saving projects, according to the irrigation district's approved water saving plan. Such a plan is intended to save water that would have been lost in the canal water transportation process and on farmland in low-efficient irrigation systems. Part of the saved water will contribute to reducing the total water use of the NXAR and the IMAR, and prevent these two regions from exceeding their corresponding water quotas. The remainder of the saved water can then be transferred for industrial development.

132. Leland A. Rolfs, *Comparing and Contrasting the Roles of the Division of Water Resources and the Groundwater Management Districts in Groundwater Management and Regulation*, 15 KAN. J. L. & PUB. POL'Y 505, 515-16 (2006).

133. YRCC, DESIGN & PRACTICE, *supra* note 37, at 32.

134. *Id.* at 31.

In the water right transfer process, the point of diversion for the industrial enterprise need not be in the same location as the water-saving engineering project of the farmer.¹³⁵ To ensure that the amount of water in the field used for crops will not be less than the amount used before the water transfer project, the farmers will be compensated in dry years, since, according to the China Technical Code on Irrigation and Drainage Engineering Works Design (GB 50288-99), the designed water supply security rate of industry is protected to 95% to 97% of its needs, while that of irrigation is only 50% to 75%. Likewise, water losses to the ecosystem, which would otherwise benefit from recharge and return flows, need to be addressed.¹³⁶

The water transfer experiment is a government-conducted process. The YRCC first requested the governments of the NXAR and the IMAR to carry out feasibility studies and to establish the Yellow River water right transfer plan at the provincial level. Provincial governments are responsible both for managing the funds provided by interested industrial enterprises and for ensuring the quality of water saving projects. Furthermore, governments determine the price of the transferred water, based on the cost estimates formulated by the MWR. Chinese water right transfers are not based on a free market, and the irrigation district will not profit from the transfer process; indeed, its revenue may shrink, since its farmers will use less water after the transfer. For example, the revenue of the South Bank Irrigation District fell by 1.1 million RMB between 2005 and 2006, due to the construction of water-saving engineering works and the water transfers that followed.¹³⁷

At this early, experimental stage of the water transfer program, the main water saving project is the lining of irrigation canals. Based on the life spans of conservation works and industrial equipment in the region, the term of any water transfer is twenty-five years.¹³⁸ Under the present water permit management system, it is the irrigation management institution that holds the water abstraction permit of the irrigation district, and the irrigating farmers who belong to that irrigation district have no corresponding individual water permits.¹³⁹ Thus, the entities in the water transfer cases are the irrigation district management institution and the industrial enterprise. As there is no clear water right for end users in an irrigation district, it is impossible for the end water user or the possible corporation of the end users to exchange its water rights in the market.

135. This is different from changes in Kansas. There, a point of diversion may be changed, but the new point of diversion must take water from the same water source. DWR has interpreted this to mean that while points of diversion from a river may move up and down the river long distances as long as no other rights are impaired by the move, wells pumping groundwater cannot be moved more than one-half mile, or about 800 meters.

136. YRCC, DESIGN & PRACTICE, *supra* note 37, at 110-11.

137. *Id.* at 194.

138. *Id.* at 104-05.

139. By contrast, members of an irrigation district in prior appropriation states in the U.S. hold shares in that district, and so have a vested property interest in the water rights held by the district. *See, e.g., In re Water Rights of Cent. Colo. Water Conservancy Dist.*, 147 P.3d 9 (2006).

Because the use of water right transfers is the only way for enterprises in the NXAR and the IMAR to obtain water abstraction permits from the YRCC, there is a large demand from the coal-based electric and chemical industries for water permits obtained from water right transfers. Until 2008, there were nineteen industrial enterprises that had been approved or would be approved to obtain water permits by investing in water right transfer projects. Overall, these approvals will create an estimated savings of 220 million m³ per year, 196 million m³ of which can be transferred for industrial use.¹⁴⁰

By the end of 2006, the YRCC had approved five water right transfer experimental projects in the NXAR and the IMAR. The water saving engineering works of the first experimental project have been finished, and they passed inspection in November 2006. A total of 42 km of irrigation canals have been lined, which is expected to save 21.73 million m³ of water per year, from which an 18.8 million m³ water use right (which is part of the water use permit of the irrigation district) was transferred to a coal-burning electric plant investing in the water saving works.¹⁴¹

In China, temporary water permits are allowed for five years, but transfers are allowed for twenty-five years. Thus, there is a discrepancy regarding the validity of the period of a water right transfer. Further amendment and a clear legal procedure are needed to address this issue. Also, the policy of the irrigation end user not having a water right should be improved to increase the marketability of individual allocations, and to prevent possible loss of rights and profits of the end users.

The water right transfer policy in the YRB has helped to solve some water problems for industrial enterprises, and it has also created a new investment channel for irrigation water savings. However, the irrigation districts that hold the water permits have not profited by these transfers. Worse, they may lose profits by supplying water to the farmers, who use less water due to the improvements in canal system efficiency, thereby reducing the districts' water fees. A policy modification might be considered to protect the interests of the irrigation districts. Water markets in the YRB could be liberalized to allow any interested entity to invest in the irrigation water saving projects and obtain profits from selling the saved water. Similarly, incentive policies to encourage groundwater use efficiency would help to reduce salinity problems. Further studies might also include the effects on farmers and irrigation district management institutions, as well as on the environment.

2. Kansas

As a result of groundwater and streamflow declines, DWR has officially closed many areas of western and central Kansas to new groundwater development. In this region, the only way to obtain a water right is by

140. YRCC, DESIGN & PRACTICE, *supra* note 37, at 110-11.

141. See generally Journal of Energy Saving and Environment Protection, available at <http://www.cnki.net>.

purchasing an existing water right. Since a Kansas water right is a real property right, it can be sold together with the land to which it is appurtenant, or the water right may be sold separately.¹⁴²

If the purchaser of a water right wants to change the use made of water, the point of diversion, or the place of use, the owner must receive prior approval of the Chief Engineer.¹⁴³ If it is determined that an application for change complies with all applicable statutes, rules, and regulations, and if approval would neither impair the use of water under an existing water right nor unreasonably affect the public interest, the Chief Engineer will approve the application for change and issue an order approving the change. Should an order be issued, the Chief Engineer may require the owners to comply with additional conditions and limitations. DWR has established an online water right database to make it easier for anyone who is interested in learning about detailed water right information.¹⁴⁴

A recent trend in Kansas is the transfer of water rights from agricultural to industrial and municipal use. However, such transfers constitute one of the most important and contentious areas of western water law.¹⁴⁵ Although the Kansas irrigator who sells his water right to an industry or city may profit from the sale, these water transfers, without investment in agricultural water conservation, will affect agricultural productivity.

Besides the technical factors, the “public interest” is also an important element for DWR in deciding whether to approve or deny the water right change application. Over the last three years, Kansas politics has been dominated by Sunflower Electric Corporation’s proposed three new 700 megawatt coal-fired electric generating plants, which it had hoped to build near Holcomb, Kansas.¹⁴⁶

These proposed plants would require water rights to provide cooling water, and those water rights will have to be obtained by transfers. Approximately 29,000 acre feet (35.8 million m³) of water from the Ogallala

142. KAN. STAT. ANN. § 82a-701(g) (Supp. 2008).

143. § 82a-708b (Supp. 2008).

144. See Kansas Geological Survey & Kansas Dept. of Agriculture, Division of Water Resources, Water Information Management and Analysis System, <http://hercules.kgs.ku.edu/geohydro/wimas/index.cfm> (last visited May 11, 2009).

145. See, e.g., Sandra Zellmer, *Anti-Speculation & Water Law: Ghost-Busting, Trust-Busting, or Ensuring Beneficial Use?*, 50 WATER RESOURCES COMMITTEE NEWSL. April 15, 2008, at 15-16 (discussing, among others, “uber-entrepreneur” T. Boone Pickens’s plan to transfer water from the Texas panhandle to Texas cities); Ruth Heide, *Mighty Miss may solve western water woes*, ALAMOS VALLEY COURIER, Feb. 11, 2009, available at http://www.alamosanews.com/V2_news_articles.php?heading=0&page=72&story_id=11609 (last visited Apr. 17, 2009) (summarizing the proposal of Gary Hauser, a Gunnison hay farmer, to establish a “Central Plains Compact” among Kansas, Colorado, Nebraska, and Missouri, to build a 1,200 mile, \$22.5 billion pipeline between the Mississippi River at Hickman, Kentucky and Monument Hill, Colorado, with laterals to the other states).

146. See generally Robert Glicksman, *Coal-Fired Power Plants, Greenhouse Gases, and State Statutory Substantial Endangerment Provisions: Climate Change Comes to Kansas* 56 KAN. L.R. 517 (2008).

aquifer would be needed for the new coal-fired power plants. Consequently, Sunflower has obtained purchase options on 29,000 acres of sand hill land and nearly 48,000 acre feet (59.2 million m³) of agriculture water rights from irrigating farmers. DWR regulations require that when irrigation water is acquired for a new use such as industrial or municipal use, the size of the water right must be reduced to account for changes in consumptive use; in this case, the optioned water rights will be reduced by approximately 40%.¹⁴⁷ These three new coal plants, combined with the existing coal plant operated by Sunflower, would use 8 billion gallons (30.28 million m³) of water a year from the Ogallala aquifer. The Ogallala aquifer is already depleted in some areas, and according to opponents of the new plants such as the Sierra Club, other parts of the aquifer will be depleted within the next sixty years or less.¹⁴⁸

Due to the uncertainty of whether the plants will be built, DWR has yet to process and approve the water rights transfers. However, KDHE held several hearings on issuing air pollution control permits. In October 2007, KDHE denied the air-quality permits necessary for these plants, provoking a fight in the Kansas legislature which continued through the 2009 Kansas legislative session. People who live hundreds or even thousands of kilometers away have joined the hot debate over the plants. In May 2009, Governor Mark Parkinson succeeded Governor Kathleen Sebelius, who joined President Obama's cabinet. Shortly after being sworn in, Governor Parkinson announced a compromise that would permit the construction of a single 895 megawatt coal-fired power plant at Holcomb. KDHE's administrative decision to deny Sunflower an air permit, the lobbying efforts on either side of the controversy in the Kansas legislature, the role of the controversy in state elections, and the governor's announced compromise all reveal the interactive and complex influences of water and environmental issues in the politics of Kansas.

F. Innovative measures to improve water management

1. The Basin: Unified Water Regulation to Ensure Minimum Streamflow

In the Yellow River Water Allocation Scheme approved by State Council of 1987, of the total of 58 billion m³ of annual average natural runoff, a total of 21 billion m³ is reserved for sediment flushing and streamflows. Only 37 billion m³ is allowed for consumption for agricultural, industrial, and domestic water use by the nine riparian provinces and autonomous regions of the Basin, as well as Tianjin City and Hebei Province in the Haihe River Basin.¹⁴⁹

The total water volume control principle is the guideline for issuing water abstraction permits. The provincial government's total of the permitted water

147. Press Release, Wheatland Electric, Holcomb Expansion (June 16, 2006), available at http://www.weci.net/news/HLC_Expansion_NewsVol_1_Issue_8_5x11.pdf.

148. Press Release, Kansas Sierra Club, Kansas Sierra Club Calls for Coal Plant Moratorium (Sept. 26, 2006), available at <http://www.kansas.sierraclub.org/Wind/Coal%20Moratorium.htm>.

149. See YRCC, YELLOW RIVER WATER RESOURCES, *supra* note 31, at 68-69.

abstraction volume is not allowed to exceed its share of the quota. Principles of unified water allocation, pro rata adjustment, and multi-year reservoir regulation have been applied since 1999. The actual water abstraction volume of each permit is proportionally adjusted each year and month subject to the actual water supply. A comprehensive water regulation decision support system was established, which includes streamflow and water quality based on a real-time monitoring system; a drought monitoring system, a water allocation and dam regulation simulation system, and an irrigation gate remote control system. Besides regular annual, monthly, and ten-day base water regulation plans, the YRCC even conducts daily regulation for the purpose of dynamically controlling water abstractions in each province and at important water abstraction sites during critical drought periods.

To prevent the river from drying up, in 2003 the YRCC set up an alarm and emergency response management mechanism for alerting district managers of the minimum streamflow discharge values of the provincial boundary hydrological stations and some other important stations.¹⁵⁰ The emergency response management mechanism was further improved in 2008.¹⁵¹ The YRCC can reduce or even stop water abstractions if the discharge of any index station falls below the minimum streamflow threshold. Although the main stem has not fallen to zero discharge since the unified water regulation was established in 1999, the river is still essentially dried up because the low river flow is too small to sustain its environmental function.¹⁵² In 2005, the YRCC initiated an ambitious integrated river basin water resources management program called “Keep the Healthy Life of the Yellow River.” This program seeks to adopt holistic approaches to deal with flood, water shortage, soil erosion, and water pollution issues, to control water demand economically, to provide sustainable water resources for social and economic development of the basin, and to keep the river ecosystem healthy.¹⁵³

One of the approaches of the program is to carry out more strict and accurate unified water regulations. Nine important tributaries of the Yellow River have been selected as the initial tributaries for intensive water resources management, and two trans-provincial tributaries, the Wei River and the Qin River, have been selected to exercise unified water allocation and regulation experiments since November 1, 2006.¹⁵⁴ The remote monitoring and control system of the lower reach at the present irrigation gates will be expanded to cover all the important irrigation gates in the upper and middle reaches. The present water allocation and regulation system for the main stem of the Yellow River will be updated to a more sophisticated basin-wide water allocation and

150. See <http://www.people.com.cn/GB/shizheng/19/20030528/1002259.html>.

151. See http://www.gov.cn/gzdt/2008-09/19/content_1100282.htm.

152. See Ni Jinren & Qian Zhenghan, *Discussion on the Functional Dry Up of the Yellow River*, 32 SCIENCE IN CHINA (SERIES E) 496, 496-502 (2002) (P.R.C.).

153. See Li Guoying, *Keep the River Healthy: A Case Study of the Yellow River*, 11 J. YELLOW RIVER 1, 1-5 (2005) (P.R.C.).

154. Xindai, *supra* note 30, at 16-19.

regulation system.¹⁵⁵

2. Kansas

Besides controls on new development, regulation of existing development, and well-spacing requirements, Kansas has adopted several new approaches to improve water management and to solve the problem of declining groundwater levels. These management programs require, among other things, annual water use reporting and water metering on all new non-domestic wells and on all wells in specially-designated areas. Currently, Kansas law requires all water right holders to report their water use information annually to the Chief Engineer.¹⁵⁶ Deliberate falsification of data on a report is a class C misdemeanor, and late reporting is subject to authorized fines. Each year, DWR mails out approximately 14,650 water use report forms to water right holders in Kansas. Of these, approximately 93% are returned to the Chief Engineer before the deadline, which has drastically improved the state water use database, yielding valuable information.

Kansas has developed many programs to retire water rights. These include the Water Transition Assistance Program (WTAP, or WaterTap) and the Conservation Reserve Enhancement Program (CREP). Under these programs, Kansas can buy back water rights from irrigators in the target project areas, and then permanently retire the water rights, to extend the useful life of the High Plains aquifer or to mitigate the spread of saline water into aquifer and stream-aquifer systems.¹⁵⁷

The City of Wichita has also developed an innovative Aquifer Storage and Recovery (“ASR”) program. The ASR program involves capturing excess flows from the Little Arkansas River when available, and then recharging that water into the Equus Beds Aquifer, just north of Wichita, to be recovered in times of drought. The plan established a priority of water use, whereby Wichita would first use its surface water rights from rivers that would normally flow through the area, saving the slowly replenished groundwater resources for times when the first-priority water is not available.¹⁵⁸ A series of systems monitor groundwater levels and quality.

DWR’s decisions regarding water rights are rooted in rigorous scientific research and technical analysis, and depend upon advanced water, land, weather, and socio-economic monitoring and analysis systems under the cooperation of government agencies, universities, and research institutions of

155. Su Maolin, *Study on the Accurate Regulation of Water Resources of the Yellow River*, 1 J. YELLOW RIVER 1, 1-2 (2007) (P.R.C.).

156. KAN. STAT. ANN. § 82a-732 (2004).

157. See Kansas Water Office, Online HydroGram (August 2007), http://www.kwo.org/kwo%20hydrogram/Article_WTAP_Aug2007.pdf; Conservation Reserve Enhancement Program, http://www.kwo.org/KWA/WPPI/Project_1.pdf (last visited April 13, 2009).

158. See Equus Beds Ground-Water Recharge Demonstration Project, <http://ks.water.usgs.gov/studies/equus/> (last visited April 13, 2009).

the U.S. For example, water quantity and quality data and many research reports are available on the United States Geological Survey website (www.usgs.com), and computer-based groundwater models are run in DWR and the Kansas GMDs to evaluate water supply.¹⁵⁹ Groundwater modeling has become particularly important in interstate water litigation and the GMDs. In both *Kansas v. Colorado* and *Kansas v. Nebraska*, the U.S. Supreme Court approved groundwater models that the states and the federal government cooperated in producing, and that set allocations and evaluate compliance under the respective compacts and settlements.¹⁶⁰

V. CONCLUSIONS

Water shortage and water allocation are serious problems in western China and the western United States, where agriculture is almost impossible without irrigation, and where energy development requires increasingly large amounts of water to be transferred from agriculture use. The Basin and Kansas are in different stages of development and have different social systems. Comparing water law and management in these disparate areas can provide for a more informed reconsideration of their water policies. Some preliminary observations and conclusions are as follows:

Both the Basin and Kansas face serious problems of streamflow declines and the drying up of rivers, mainly due to rapid irrigation development and agricultural water consumption. In the Basin, irrigation efficiency is very low because traditional and cheap irrigation methods dominate. The low efficiency irrigation system has resulted in an over-abstraction of surface water, and has caused salinity problems in large irrigation districts, especially the irrigation districts of the NXAR and the IMAR in the northwest part of the Basin. At the same time, water users are causing serious groundwater depletion and a continuous decline of the water table in the Basin. In Kansas, irrigation efficiency is relatively high due to the wide-spread use of center pivot irrigation systems. But these systems have overexploited the groundwater, causing water table declines, particularly in southwest Kansas.

Current surface water diversions from the Yellow River, combined with present groundwater diversions, remain much less than the estimated renewable groundwater storage in the region. If groundwater supplies had been properly developed before the surface irrigation projects, it is likely that neither the NXAR nor the IMAR would have overused their surface quotas, overuse which took water that should have been used by downstream users and

159. See Kansas Water Office, Online HydroGram (August 2007), http://www.kwo.org/kwo%20hydrogram/Article_WTAP_Aug2007.pdf; Conservation Reserve Enhancement Program, http://www.kwo.org/KWA/WPPI/Project_1.pdf (last visited April 13, 2009).

160. *Kansas v. Colorado*, No. 105 Orig., Fifth and Final Report of the Special Master, vol. III, App. C.1, Hydrological-Institutional Model Documentation (Jan. 2008); *Kansas v. Nebraska & Colorado*, No. 126 Orig., Final Report of the Special Master with Certificate of Adoption of RRCA Groundwater Model (Sept. 17, 2003).

remained in the River. Moreover, reduced surface diversions would have significantly reduced the surface irrigation water-induced salinity problems. Since the cost of groundwater irrigation (both tube well construction costs and electricity costs to operate the pumps) is higher than that of surface water irrigation,¹⁶¹ less than thirty percent of the tube wells are actually used.¹⁶² An incentive policy for proper groundwater development could be considered. Due to the large discrepancy among estimates of available groundwater in the Basin, further coordination and cooperation among the many different government departments might be considered to improve water management in China. Also, due to this discrepancy there is still need for further coordination and cooperation among the many different government departments.

Since 1945, Kansas has employed a rather complete legislative and institutional system to deal with the water resources management problems, and the system is still evolving and improving. By contrast, the water law system in the Basin has lagged behind. Both the institutional setting and water laws are still in a developing stage that corresponds with ongoing policy changes and economic reforms in China. To avoid conflicts in sector policies and overlaps in responsibilities, and to achieve coordination in water, food, and energy policy, China and the Basin might consider establishing organizations similar to those in Kansas: the Kansas Water Authority, the Kansas Water Office, and the cabinet-level water group responsible to the governor for establishing a holistic and coordinated basin-centered water development plan and policies to handle water crises. A special assistant to the governor helps bridge water, food, and energy issues. In addition, broad stakeholder participation in decision making and a public hearing process should also be adopted in water rights transfers, water permit evaluations, and inspection processes to avoid possible side impacts to third parties.

Like the Kansas water permit system, the system in the Basin is used to allocate surface water and groundwater. However, unlike Kansas, every Basin permit is a short-term permit that has to be renewed normally every five years with the priority decided by water use type instead of priority date. The short-term water permit system in China gives the water administration the flexibility and power to adjust water allocation policy in the changing natural and socio-economic environment. This flexibility makes it easier for the government agency to adjust its water management to protect the overall public benefit and the environment. However, the system also leaves the risk that institutions and individuals may lose their water permits and associated interests without reasonable compensation from the government. China might

161. Wu Yong, *Ningxia is Short of Water Even Though the Yellow River is Nearby*, XINHUA NEWS AGENCY, Sept. 5, 2003, http://news.xinhuanet.com/focus/2003-09/05/content_1065632_1.htm. It is roughly estimated that the comprehensive irrigation water fee of surface water and groundwater is 1.5 cents and 9 cents RMB per cubic meter, the cost of groundwater irrigation is about 5 times higher than the surface water in NXAR. *Id.*

162. THE HYDROLOGY BUREAU OF NINGXIA (HBNX), THE YELLOW RIVER WATER RIGHT TRANSFER MASTER PLAN OF THE NINGXIA AUTONOMOUS REGION (2005) (P.R.C.).

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consider changes to correct the inconsistency between the short-term period of the water permit and the long term allowed in water rights transfer projects. Likewise, Kansas might consider changing its permanent water right system to a quasi-permanent one, in order to adapt to changing social and economic conditions. The difficulty in Kansas on this front, however, is that the U.S. Constitution protects property rights from being taken, indeed perhaps significantly even changed, without compensation. Kansas could begin, however, by limiting the terms of new permits and not making them perpetual.

In China, it was not until the new water permit management regulation of China was issued in 2006 that water use rights were first allowed to be transferred. To encourage water savings and improve water use efficiency, only water saved through adopting water saving approaches under a water permit may be transferred for profit. In Kansas, water rights are property rights that can be bought and sold in the market. China might consider allowing more liberal water rights transfers to enable more water to flow to more highly efficient and productive users. However, just purchasing water rights from the market without a required and accompanying investment in agricultural water savings in Kansas invariably affects agricultural productivity, although the individual farmer who sells water may derive more profit from the sale. China would necessarily have to bear its food security issue in mind in studying whether this kind of water right transfer approach is suitable.

In the Basin, the combination of a water permit system for water allocation and the unified water regulation system for daily water abstraction monitoring and management has proven to be a successful approach to ensure that water is fairly and equally used among different provinces, while also assuring that the minimum environmental flow demand is met. However, under Kansas's prior appropriation water right system, the MDS cannot always be ensured. Thus, the only way to ensure MDS is to buy senior water rights.

The IWMI-Kansas Program held in Kansas in 2006 was successful in bringing water professionals together from different countries to learn from each other. The provincial and state governments in China, the U.S., and other countries should continue to collaborate with and aid IWMI by facilitating, establishing, supporting, sponsoring, and helping fund similar programs for the study of comparative water law and policy. Future programs could broaden the scope of participation by including other types of scientists, economists, lawyers, law professors, and other state and governmental officials.