China’s Water Scarcity and Its Implications for Domestic and International Stability

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Abstract: This article is based on a review of current literature to ascertain relationships among water scarcity, economic growth, and social stability in China, with particular emphasis on identifying any mechanisms by which China’s water scarcity could lead to political instability. First, the author examines the magnitude and extent of water scarcity and distribution issues in China, including current trends with respect to water usage and availability and the resulting economic impacts, highlighting the ultimate necessity of an effective government response. He then assesses current government policies and determines them to be inadequate to alleviate water scarcity, while at the same time, such policies engender antagonism between different regions within China. Finally, the author examines the social, economic, and political consequences of some of the most common and obvious policy prescriptions for addressing water scarcity issues. From this emerge numerous potential mechanisms by which these policies could threaten domestic stability if implemented in the political and economic context of China, as well as several factors that point to the likelihood of China’s leaders channeling popular frustration externally, to the detriment of both regional stability and great power relations. China’s water scarcity issue thus not only poses a significant

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resource management challenge but also carries potentially serious ramifications for international peace and security.

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With more than 20 percent of the world’s population but less than 7 percent of its freshwater resources, China is increasingly facing issues associated with the scarcity of water. This problem is particularly acute in northern China, where water use substantially exceeds sustainable quantities and demand continues to grow. Given the mounting severity of the current water scarcity issues afflicting northern China, government action is required to mitigate further deterioration of the situation—and, indeed, the Chinese government is taking action to address some of these issues. However, although many alarmist fears of scarcity-induced conflict prove unwarranted, as economic price signals and government policies allow the society to adapt to changing conditions, in the case of China, those very adaptations could potentially prove more destabilizing than the scarcity itself.

Government-imposed measures to provide an effective long-term solution potentially jeopardize the sustained high gross domestic product (GDP) growth rates the Chinese Communist Party (CCP) views as instrumental to maintaining its legitimacy. Even policy alternatives more conducive to economic growth risk generating other forms of social upheaval, including regional or sectoral tensions. Nationalism—whether intentionally fostered by the CCP to unify conflicting or aggrieved domestic elements behind the national government, or reluctantly adopted by the CCP to co-opt a reactionary backlash by elements favoring a return to greater centralized control over the economy and insularity from the vagaries of global market forces—could transform Chinese domestic tension into regional, or even global, tension. Consequently, the Chinese government’s response to water scarcity issues over the next few decades will have a critical impact on regional security in South and Southeast Asia, as well as implications for its long-term relationship with the United States.

**Current Water Scarcity Issues**

Of its 668 largest cities, the Chinese government has classified 300 of them as short of water, with 108 identified as “serious” and 60 “critical.” The annual urban freshwater shortage is estimated at 5–6 billion m$^3$, and urban demand continues to grow at 10.1 percent annually. With irrigated areas already experiencing shortages of 30–35 billion m$^3$ annually and industrial demand growing at 5.4 percent annually, China’s water scarcity problem is severe and worsening. Water levels in rivers have dropped to the point that they caused power outages, as hydroelectric plants lacked sufficient flow for electricity generation, and economic losses attributable to water shortages in the urban areas of northern China alone are assessed by the Chinese Academy of Sciences as equivalent to 3 percent of the total Chinese
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GDP. The Chinese government predicts that by 2030, China’s annual freshwater shortage will reach 200 billion m$^3$, exceeding its current annual consumption.

With China’s available water largely concentrated in the south, northern China faces particularly severe freshwater scarcity issues. Northern China encompasses 42 percent of the population (538 million people) and 40 percent of China’s cultivated land. It also produces 31 percent of the GDP but has only 14 percent of China’s fresh water. The United Nations (UN) and World Bank define water stress as annual per capita water availability of 2,000 m$^3$ or less and water scarcity as 1,000 m$^3$ or less. By comparison, per capita availability in the Hai River basin is only 343 m$^3$. This extreme scarcity has led to the mining of aquifers, annually extracting 8.8 billion m$^3$ in excess of the recharge flow. Consequently, groundwater tables in the Hai plains have dropped as much as 90 m, those under Beijing have dropped 100–300 m, and water tables continue to drop about 1.5 m per year. Beyond requiring deeper wells, shrinking water tables have led to salt water intrusion in coastal areas, affecting seventy-two locations over an area of 142 km$^2$. This degrades agricultural productivity and effectively reduces available water supplies even further by requiring expensive desalinization of water from previously productive wells. Shrinking water tables have even led to serious subsidence. Beijing has sunk three-quarters of a meter over the past forty years, and continues to sink approximately two centimeters per year, while the center of Shanghai has sunk almost two meters over the past forty years. Structural damage from subsidence was estimated at 1.14 billion yuan in 1985 alone.

Given the growing magnitude of water scarcity and its associated issues across northern China, is there a risk of social unrest? Numerous studies of the impact of environmental scarcity on conflict have consistently demonstrated little or no relation between the two, and even where a positive correlation is established, the magnitude is very small relative to the other variables, particularly economic and political factors. Some neo-Malthusian arguments identify the requirement for “important intervening variables between environmental scarcity and conflict,” including “decreased agricultural production, decreased economic activity, migration, and weakened states.” Conversely, neoclassical economists argue that society will adapt to scarcity through adjustment to the changing price signals brought on by increasing demand or decreasing supply. All of these results, while seemingly dispelling concern over the likelihood of scarcity-induced conflict, actually bode very ill for long-term stability in China. For in the case of China, it is not in response to conditions of scarcity that conflict threatens; it is in response to the economic consequences of government actions taken to address that scarcity.

### Impact of Current Government Actions

With agriculture consuming 69 percent of China’s available fresh water, improving irrigation efficiency has received considerable attention. However, improvements in this area have not only failed to relieve water scarcity but to some
extent have made it worse. First, improved irrigation efficiency has not appreciably reduced agricultural demand for water, as most of the water saved has simply been used to increase the area under irrigation. Second, dramatic reduction in traditional irrigation losses in the form of spillage and leakage has curbed flows that previously contributed to recharging aquifers, thereby significantly reducing aquifer recharge rates and thus the sustainable level of aquifer output. Finally, similar attempts to curb water losses caused by evaporation and transpiration, if successful, would reduce the atmospheric moisture that contributes to precipitation, thereby likely increasing demands on irrigation while reducing both river flow and aquifer replenishment. Failing to consider the impact of policy decisions on the full hydrologic cycle thus merely shifts problems without providing any sort of long-term solution.

Given China’s penchant for public works projects and freshwater availability in southern China averaging 3,208 m$^3$ per person (compared with 757 m$^3$ per person in northern China), it is not surprising that at least partial alleviation of water shortages is being sought in the form of a massive South-North Water Diversion Project. Three tunnels, each over 700 miles long, will divert water from the upper, middle, and lower reaches of the Yangtze River system in the south to points on the Yellow River system in the north. When completed, they will transfer a total of 38–48 billion m$^3$ annually—5 percent of the total Yangtze River flow.

Beyond concerns about the adequacy of such south-north flows to substantially relieve water scarcity in northern China, it is unclear to what extent the Chinese government has considered future changes to freshwater availability in southern China. What is clear, however, is that barring a major shift in regional weather patterns that brings significantly greater moisture to the area, water supplies in southern China will decrease in the future. The additional runoff from the shrinking of Himalayan glaciers provides glacier-fed rivers with a flow that currently exceeds that which is sustainable over the long-term. Moreover, all potential futures ultimately lead to reduced runoff: If the glaciers continue to shrink, eventually they will be gone, and with them the contribution of river flow attributable to melting; if the glaciers stop shrinking, the effect on river flow would be equivalent to that in the complete loss of glacier case, since they will no longer be contributing melt water; if glacier shrinkage reverses, river flows will be proportionately less than those in the previous two cases, as a portion of atmospheric moisture that would otherwise contribute to river flow is retained by the expanding glacier. With water supplies reduced by the loss of glacier runoff, increases in water demand in the south (from economic growth, population growth, and improvements in living standards) could create resentment or even hostility over continued water diversion to the north.

Chinese administrative responses to water scarcity, primarily in the form of controls and quotas, are mostly ineffective. The Ministry of Water Resources operates river basin commissions, but they are largely ignored. Because “government agencies of the same rank cannot issue binding orders to each other . . .
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a national ministry cannot issue a binding order to a provincial governor.”29 This, combined with the “national economic deal” in which “each level of government will grant the level below it sufficient flexibility to enable the lower level to grow its economy rapidly enough to maintain social and political stability,” encourages local officials to disregard limits and regulations that could impede local economic growth regardless of the consequences to neighboring or downstream regions.30

Impact of Potential Government Actions

Given the steadily deteriorating situation and the overall inadequacy of current measures, more dramatic action is plainly necessary. However, this becomes problematic for the Chinese government. Even if future demand growth does not overwhelm improvements in water use efficiency,31 the fact remains that current water use is unsustainably high, and therefore future water use must be reduced below current rates of consumption. Strict government allocation—and enforcement—of water between competing regions and between competing sectors of the economy risks alienating some, if not all, of the parties involved and would be economically inefficient. Because resources would not be free to shift to where they would be most productive, economic output would be less than economic potential. Furthermore, to the extent that additional regulation and limits increased manufacturing costs, price competitiveness or profit (or both) would decrease, likely slowing manufacturing growth and creating resentment on the part of the manufacturing elite. The lower and middle classes would harbor grievances as well, as the slowing economy would hinder upward mobility and water use limits would curb the attainment of modern Western living standards. To what extent this economic dissatisfaction would manifest itself in political instability is impossible to predict, but even if the economic grievances themselves were of insufficient magnitude to spawn popular opposition to the government, widespread disaffection could be exploited by prodemocracy agitators. The fact that these economic grievances could be specifically attributed to official government policy, coupled with broad dissatisfaction across large segments of society, could make the Chinese populace particularly supportive of those demanding popular control of government.

One readily available option for addressing at least a portion of the freshwater scarcity while minimizing the impact on economic growth would be to abandon the Chinese government objective of self-sufficiency in food (grain) production.32 This would allow available water to be employed in more economically productive applications while effectively increasing freshwater supplies through the importation of “virtual water” in the form of food.33 However, this, too, is not without potentially significant ramifications. First, declining agricultural production would cause an already large rural-to-urban migration to accelerate, likely generating resentment on the part of both new and current urban residents over diminished economic opportunity and deteriorating living conditions. China already has one
of the world’s highest rates of urbanization (4–5 percent annually through the 1980s and 1990s, resulting in 150 million additional city dwellers every decade), and urban population growth that outpaces employment growth has been empirically linked with domestic political violence. Continued stability in the face of accelerated urbanization would thus require continued rapid (if not accelerated) economic growth.

Second, reduced domestic production would increase the quantity of food demanded on global markets, driving up global food prices. Fears of widespread popular discontent over higher food prices could force the Chinese government to take on the fiscal burden of subsidizing its population for these higher costs. Finally, with substantially larger imports of food—and those at higher prices—the Chinese trade surplus would be reduced, at least temporarily. Although ultimately beneficial—and probably unavoidable—the imposition of such a policy would expose Chinese leaders to some risk during the transition period. A diminished trade surplus, coupled with the abandonment of such a conservative national objective as food self-sufficiency, could conceivably create a right-wing backlash, particularly in a context of lingering apprehension of strategic encirclement and vulnerability to foreign coercion. While the actual overthrow of the Chinese government seems unlikely, such a backlash could facilitate the assumption of greater power by more conservative elements within the CCP or encourage existing leaders to adopt a more nationalistic stance to preclude any threat of ouster.

Although Chinese freshwater scarcity is substantially aggravated by rapid economic growth in a context of artificially low costs for fresh water, alleviation through market-based pricing of water would almost certainly be politically untenable. Currently, water prices range from 0.5–0.9 yuan per m³, despite the marginal cost of water projects exceeding 1.2 yuan per m³, with desalination plants costing 4–7 yuan per m³ and the South-North Water Diversion Project anticipated to be 7–8 yuan per m³. Market pricing would thus require additional price increases of up to 1,500 percent—in a society culturally resistant to paying for water. Moreover, irrigation costs in northern China represent 10 percent or more of nonlabor production costs for wheat and corn, compared with less than 2 percent in the United States, the European Union, Canada, and Australia. The resulting jump in production costs, on top of rural incomes that are already less than one-third urban incomes and growing only half as fast, would risk a major rural backlash. If market forces were also allowed to allocate this competitively priced water, the high fraction of input costs attributable to water, coupled with the relatively low economic productivity of water in agriculture (e.g., 1,000 tons of water yields 1,600 yuan worth of wheat or 112,000 yuan worth of manufactured goods), would virtually ensure the collapse of the agricultural sector in China. In any case, urban dwellers would see their quality of life plummet, as jumps in food and water prices led to an increase in the cost of living, while massively accelerated migration from farms
to cities led to overcrowding and intense competition for jobs. The higher cost of water as an input to the manufacturing process would reduce price competitiveness or profit (or both), constricting manufacturing growth and further limiting economic opportunity. Because it adversely affects virtually all segments of the population—and to such a significant degree—market pricing of water would almost certainly be more threatening to the continued authority of the CCP than the water scarcity problems it was intended to address.

Although frequently derided in the literature for over-predicting domestic political violence, deprivation theory provides a model for potential instability in China. The free-rider problem, and the lack of sufficient resources to have any rational expectation of success, make the mass rebellion predicted by deprivation theory far less prevalent than the elite coups predicted by rational choice theory. In the case of China, however, existing ethnic, regional, or even village groups could resort to collective action, while “at least some deprivation theories . . . build on the idea that frustration may lead to aggression, to some degree irrespective of the consequences of violence in terms of expected utilities.” This appears to be borne out to some extent already in China, which experienced 87,000 demonstrations against the government in 2005, an increase of 58 percent in two years.

Alternatively, rational choice theory could explain violence instigated by Chinese elites. Since both the highly educated and those with very high incomes tend to have less trust in the Chinese government, perceived vulnerability of the Chinese government (such as fiscal weakness and widespread unpopularity from water scarcity abatement measures) could prompt prodemocracy groups or wealthy business interests to seize the opportunity to create change more conducive to their own best interests. Unsatisfied demand for social mobility by educated youth has been empirically demonstrated to draw elite discontent and increase the risk of domestic political violence. Potentially, a nationalist movement opposing the CCP for its failure to satisfy the needs and aspirations of the Chinese people could draw the support of both the masses and the elites. Because nationalism could be employed as a unifying force in rebellion (with a potency second only to religion), politically the CCP has almost no choice but to preempt any nationalist sentiment and channel it externally.

**External Ramifications**

There is a rich history of international cooperation with respect to shared water resources. Since the last war over water more than 4,500 years ago, there have been more than 3,600 treaties concerning water issues, including about 300 since 1814 specifically addressing non-navigational issues. In 1997, the UN General Assembly adopted a convention governing non-navigational use of international waterways. There are indications, however, that China may prove less
accommodating than the historical norm. For example, China was one of only three countries to vote against the 1997 UN convention.\textsuperscript{53} Similarly, when Cambodia, Laos, Thailand, and Vietnam established the Mekong River Commission in April 1995, China refused to sign the agreement.\textsuperscript{54} With three dams on the Mekong already, and five more either planned or under construction (including two that will be exceptionally massive),\textsuperscript{55} China has tremendous impact on the water policy options of the Southeast Asian states, but lying upriver of all of them, China seems to have discounted the need for a multilateral approach to river use.\textsuperscript{56}

The Mekong represents only a fraction of the potential leverage China could exert over the region, however.\textsuperscript{57} Tibet is the ultimate source of major rivers into China, India, Pakistan, Bhutan, Nepal, Bangladesh, Myanmar, Cambodia, Laos, Thailand, and Vietnam, countries encompassing 47 percent of the world’s population.\textsuperscript{58} Of all the major rivers originating in the Himalayas, only the Ganges originates outside Tibet.\textsuperscript{59} Several circumstances converge to significantly raise the feasibility of China exploiting this potential leverage. First, such a stance provides an external outlet for any nationalist sentiment fostered to unite the country under CCP leadership. Second, action in this arena could directly address underlying issues associated with water scarcity by providing additional freshwater resources with which to placate social and economic demands. Third, the Three Gorges Dam and the South-North Water Diversion Project indicate a willingness to undertake water redistribution projects on a massive scale, as well as provide experience in constructing such works. Fourth, since almost all major regional watersheds originate in Chinese territory, their waters could be appropriated with no actual military action required on the part of China. Any attempts by downstream countries to physically resist unilaterally imposed flow diversions would necessitate their being the military aggressor. Finally, there is already a constituency of former officials advocating such a policy through a book entitled \textit{Tibet’s Waters Will Save China}.\textsuperscript{60}

In addition to potential regional tensions, nationalism could also manifest itself in the form of strong anti-Americanism. Beyond the mere rivalry between an emergent global power and the reigning superpower, hostile sentiment could also arise from (or be amplified by) a sense of relative deprivation with respect to freshwater resources. The Chinese per capita average of approximately 2,000 m\textsuperscript{3} (predicted to be down to 1,700 m\textsuperscript{3} by 2030) is dwarfed by the U.S. per capita average of 10,332 m\textsuperscript{3}.\textsuperscript{61} Moreover, the Chinese urban per capita use rate (230 liters per day in 1997) will likely never reach the current U.S. rate of 400–700 liters per person per day.\textsuperscript{62} This perpetual inferiority of living standards—real or perceived—could easily create jealousy and resentment that the CCP would only be too happy to channel externally. While such jealousy could also create resentment against the CCP for its inability to provide a standard of living comparable to that in the United States, such elements, even were they to come to power, would almost certainly not be any more amenable to U.S. interests.
Conclusion

Fundamentally, the freshwater scarcity problem in China is a manifestation of the conflict between market-driven economic growth and government-imposed social stability. With current water use exceeding sustainable levels and demand continuing to grow, effective government response cannot be postponed indefinitely. However, such a response will almost certainly impact the rapid, sustained economic growth intrinsic to the continued legitimacy of the CCP. Even with policy responses that may be economically prudent over the long-term, there is a risk of creating highly destabilizing conditions during the transition period. Moreover, these conditions have empirically been associated with internal political violence on the part of the masses, elites, or both. The CCP, however, may be well-positioned to redirect hostility outward, to the detriment of regional stability and great power relations.

The United States must be prepared to manage, or at least contain, any regional instability. In addition, the United States should offer to assist China with developing and implementing solutions to its water scarcity problems. Despite realist concerns about the potential threat to the United States from growing Chinese national power, neither a Chinese domestic implosion, nor external aggression instigated by China to forestall such an implosion, is in the best interest of the United States. Although transition to a more democratic form of government may ultimately be beneficial to the United States, the region, and the world, the negative consequences—to the global economy and to stability in South Asia, Southeast Asia, Northeast Asia, and even Central Asia—of any substantial transient instability would almost certainly dwarf the benefits from Chinese domestic political reform. Moreover, there is no guarantee that any regime change would result in democratic government or that the resulting regime would be any more inclined to operate more cooperatively with the United States or the international community. Although there may be little the United States can do to directly prevent Chinese internal (or regional) instability, proactive engagement and close monitoring of Chinese initiatives will be essential to anticipating and mitigating any detrimental international consequences.

NOTES

1. Kathleen A. Cannon, "Water as a Source of Conflict and Instability in China," Strategic Analysis 30, no. 2 (2006): 310. Water quality in China is also a serious problem because of widespread pollution. Although this effectively reduces the available water supply still further and creates tension between different segments of the population, discussion of water quality issues is beyond the scope of this article, because ultimately water pollution can be somewhat more easily addressed than absolute water scarcity.

2. Prosperity has replaced ideology as the justification for CCP rule: “Over time, the reform process and continued economic growth have ceased to be a means to put China back on a socialist track—which is how they were originally posed in CCP writings—and have become ends in themselves. . . . The goal of achieving ‘advanced socialism’ was redefined as realizable through market competition. . . . Socialism itself was redefined as ‘common prosperity’ and the Party constitution was subsequently


10. Ibid., 9.

11. Ibid., 10.

12. Ibid.; and Navarro, Coming China Wars, 156.


14. Ibid.

15. Navarro, Coming China Wars, 156.


23. Interestingly, there has been no appreciable shift in population from north to south, with the relative fraction in each region remaining virtually constant between 1980 and 2000. Shalizi, Addressing China’s Growing Water Shortages, 7, 24–25.


25. Wolf et al., Fault Lines, 89.

26. With China’s monsoon climate, glacial melt is also important for buffering seasonal and annual variations in precipitation, particularly in the flood-prone south. To maintain this buffering capability—and stabilize the water flow to the north—a number of new dams will likely be required.


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36. All other factors remaining the same, additional food imports would reduce the Chinese trade surplus unless—and until—additional manufactured goods (produced using the sustainable portion of water formerly devoted to agriculture) could be exported for more than the value of the food imports.
37. Although water prices have been raised to some extent, this would be a significant policy shift. “The Chinese Communist Party has singled out ‘rural unrest as the biggest threat to its rule’ and Jiang Zemin has set boosting agricultural production, increasing farmers’ incomes, and maintaining stability in the villages as priorities.” Cannon, “Water as a Source of Conflict,” 314. “For a long time, government policy kept water prices low as part of a larger strategy to keep farmers in their fields in order to avoid the huge social implications of a rush to the cities.” Shalizi, Addressing China’s Growing Water Shortages, 13. In October 2006, President Hu Jintao spearheaded “a new Party initiative to reduce the growing inequalities in Chinese society, with a particular focus on urban employment conditions and rural farming rights.” Morgan, “China’s Growing Pains,” 431. Abandoning such professed policies would likely magnify displeasure with the government among affected elements of the population by engendering a sense of betrayal. The 2009 World Bank report Addressing China’s Water Scarcity recommended marginal opportunity cost pricing of water but warned that “its social impact, especially the income impact on the poor, has to be addressed.” Jian Xie, Andres Liebenthal, Jeremy J. Warford, John A. Dixon, Manchuan Wang, Shiji Gao et al., “Addressing China’s Water Scarcity,” (World Bank Report 47111, International Bank for Reconstruction and Development and World Bank, Washington, DC, January 1, 2009), 139.
38. Wolf et al., Fault Lines, 92; and Jian et al., Addressing China’s Water Scarcity, 27.
39. Shalizi, Addressing China’s Growing Water Shortages, 20; Wolf et al., Fault Lines, 92. Recognition of the utility of raising water prices to reduce (or reduce the growth rate of) water consumption may be spreading, however. The PRC Ministry of Water Resources reported that at a public hearing of the Beijing Municipal Development and Reform Commission held in December 2009, a majority of those representing public stakeholders supported a proposed 24.3 percent increase in the price of water for residential use (from 3.7 to 4.6 yuan per m³). The plan includes government subsidies for low-income families, but a journalist at the hearing reported widespread public disapproval of the proposal, and concerns were expressed regarding the level of water consumption by migrant populations and industry. In November 2009, nonresidential water prices were raised 48.6 percent, and several other cities, “including Shanghai, Tianjin, Shenyang, Guangzhou, Nanjing and Chongqing,” are also considering water price increases. Ministry of Water Resources the People’s Republic of China, “Beijing Hikes Water Price to Ease Shortage,” Ministry of Water Resources, December 22, 2009, http://www.mwr.gov.cn/english/news/200912/t20091223.159422.html (accessed January 27, 2010).
49. Ibid., 5, 10, 14.
57. For example, with Chinese damming of the Brahmaputra River, “India and Bangladesh would be at China’s mercy during the dry spell and for protection from floods during the rainy season.” The Brahmaputra River alone “accounts for nearly 30 percent of the total water resources and about 40 percent of the total hydropower potential of the country [India].” Zeenews Bureau, “RS Agency
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58. These rivers include the Indus, Mekong, Yangtze, Yellow, Salween, Brahmaputra, Karnali, and Sutlej. Chellaney, “China Aims for Bigger Share.”

59. Ibid.


2point6billion.com, “Uncertainty Over China’s Aims for Brahmaputra River,” Asia Briefing, October 19, 2009, http://www.2point6billion.com/news/2009/10/19/uncertainty-over-china%E2%80%99s-aims-for-brahmaphutra-river-2652.html (accessed February 7, 2010). Although an expert-level mechanism was established in November 2006 to facilitate information sharing between China and India, Indian efforts to broaden this exchange beyond flood season data have been unsuccessful. Samanta, “China Begins Building Dam”; and 2point6billion.com, “Uncertainty Over China’s Aims.”

61. Navarro, Coming China Wars, 152; Wolf et al., Fault Lines, 75; and Shalizi, Addressing China’s Growing Water Shortages, 4.
