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FROM ARMS RACING TO "DAM RACING" IN ASIA

HOW TO CONTAIN THE GEOPOLITICAL RISKS OF THE DAM-BUILDING COMPETITION

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On the cover: Three Gorges Dam. © Lu Heng

From Arms Racing to "Dam Racing" in Asia

How to Contain the Geopolitical Risks of the Dam-Building Competition

Transatlantic Academy Paper Series

May 2012

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Introduction

Asia's phenomenal economic rise has attracted a lot of attention in international policy circles but the sharpening water competition this growth has triggered is less well known. Water has emerged as a source of increasing competition and underlying discord between many Asian nations, spurring new tensions over the resources of transnational rivers. Asia's fastest-growing economies are all at or near water-stressed conditions, underscoring how water shortages threaten to hamper the continent's continued rapid economic growth. For investors, the Asian water crisis carries risks that are at least as potentially damaging as nonperforming loans, real estate bubbles, and political corruption.

Dam building on transnational rivers is at the heart of the inter-riparian tensions in Asia. Asia is already the world's most dam-dotted continent: It has more dams than the rest of the world combined. Yet the numerous new dam projects in Asia show that the damming of rivers is still an important priority for policymakers. In the West, dam building has largely petered out. In Asia, however, the construction of new dams continues in full swing.

Like arms racing, "dam racing" has emerged as a geopolitical concern in Asia, where the world's fastest economic growth is being accompanied by the world's fastest increase in military spending and the world's fiercest competition for natural resources, especially water and energy. As riparian neighbors compete to appropriate resources of shared rivers by building dams, reservoirs, barrages, irrigation networks, and other structures, the relationships between upstream and downstream states are often characterized by mutual distrust and discord.

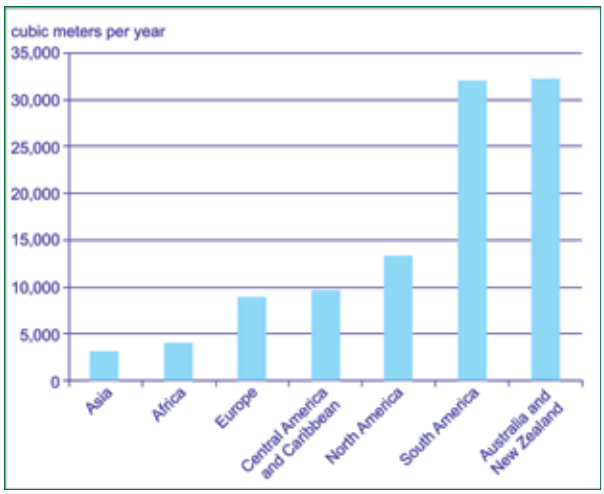
This paper warns that just as the scramble for energy resources has defined Asian geopolitics since the 1990s, the struggle for water is now likely to define many inter-country relationships. At a time when many territorial disputes and separatist struggles in Asia are being driven by resource issues — extending from the energy-rich South and East China Seas to the water-rich Tibet and Kashmir — water is indeed becoming the new oil. But unlike oil — dependence on which can be reduced by either tapping other sources of energy or switching to other means of generating electricity — there is no substitute for water. Asian economies are the world's leading importers of resources like mineral ores, hydrocarbons, and timber, importing them from distant lands. But they have no such import choice on water.

The paper, drawing on the author's book on Asian water challenges published in 2011 by the Georgetown University Press, examines how the rising geopolitical risks arising from the dam-building competition can be stemmed. It does so by examining the broader water tensions and competition, which center on four distinct zones: China and its neighbors; South Asia; Southeast Asia; and Central Asia, where the Soviet Union's disintegration left a still-festering water discord among the five so-called "stans" — Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan, and Turkmenistan.

The overexploitation of river resources has only promoted unbridled groundwater extraction, resulting in rapidly falling water tables across much of Asia. The scope of this paper, however, is limited to analyzing how the resources of shared rivers have become the target of rival appropriation plans in what can be described as a silent hydrological warfare. Driving the rival dam-building plans and the accompanying water nationalism is the notion that sharing waters is a zero-sum game. The danger that the current or new riparian disputes may escalate to conflict looms large on the Asian horizon, with important implications for Asia's continued rapid economic-growth story and for inter-riparian relations.

In Asia, the world's fastest economic growth has been accompanied by the world's fastest increase in military spending and the world's fiercest competition for natural resources, especially water and energy.

Figure 1: Per-capita Freshwater Availability in Different Regions



Source: Based on United Nations data, 2012.

The challenges posed by the frenetic dam building, however, come with new opportunities to break with business as usual and adopt water conservation and efficiency as well as cooperative approaches to help sustainably manage shared water resources and underpin mutual development goals and environmental security. What Asia needs is institutionalized water cooperation between co-riparian states, with clear rules on building dams on transnational rivers.

Only cooperative water institutional mechanisms can help mitigate the risks arising from the rush to dam rivers and create an upstream hydro-engineering infrastructure that could potentially arm upstream states with tremendous political and economic leverage over downriver nations. Such cooperation will need to be based on transparency, information sharing, independent environmental impact assessment, dispute-settlement mechanisms, water pollution control, and a mutual commitment to refrain from undertaking projects that could materially diminish transboundary river flows.

1 The New "Dam Racing"

Dam building on shared rivers is often at the root of Asian inter-state and intra-state disputes and tensions. Unilateral and non-transparent dam-building activities have only intensified water discord in Asia, with important implications for regional security. The construction of dams by China in its borderlands and by states in Central, South, and Southeast Asia has roiled inter-riparian relations. As states strive to meet their evolving water and energy needs by building dams, water is becoming a source of competition and discord, making basin cooperation more difficult to promote.

Asia, with 70 percent of the world's total irrigation land, is the global irrigation hub. But less publicized is the fact that Asia is also the global dam center. It is the world's most dam-dotted continent. Yet the over-damming of many rivers has only compounded the water challenges in Asia.

Dams, to be sure, bring important benefits. If adequately sized and designed, dams can aid economic and social development by regulating water supply, controlling floods, facilitating irrigation, and storing water in the wet season for release in the dry season. In addition, they help generate hydroelectricity and bring drinking water to cities, when they are designed for such purposes. But upstream dams on shared rivers in an era of growing water and environmental stress often carry broader political and social implications, especially because they can affect the quality and quantity of downstream flows. Dams, by often altering fluvial ecosystems and damaging biodiversity, also carry environmental costs.

Globally, the vast majority of dams were built between 1950 and 2000. Dam building has largely petered out in the West, but continues in full swing in Asia, where a host of countries are involved in dam-construction activities. Just one country, China, boasts slightly more than half of the approximately 50,000 *large* dams on the planet.[1] A large dam is defined by the International Commission on Large Dams (ICOLD) as a structure with at least "a height of 15 meters from the foundation or, if the height is between 5 to 15 meters, having a reservoir capacity of more than 3 million cubic meters."[2]

According to international projections, the total number of dams in developed countries in the next ten years is likely to remain about the same, while much of the dam building in the developing world, in terms of aggregate storage-capacity buildup, is expected to be concentrated in Asia, especially China. Indeed, about four-fifths of all dams currently under construction in Asia are in China alone.

In the United States — the world's second most dam-dotted country after China — the rate of decommissioning of dams has overtaken the pace of building new ones. This is partly because of the diminished availability of good damming sites. In Asia, too, most of the good dam sites have already been taken. Yet the numerous new dam projects in Asia highlight that the damming of rivers is still an important priority for policymakers.

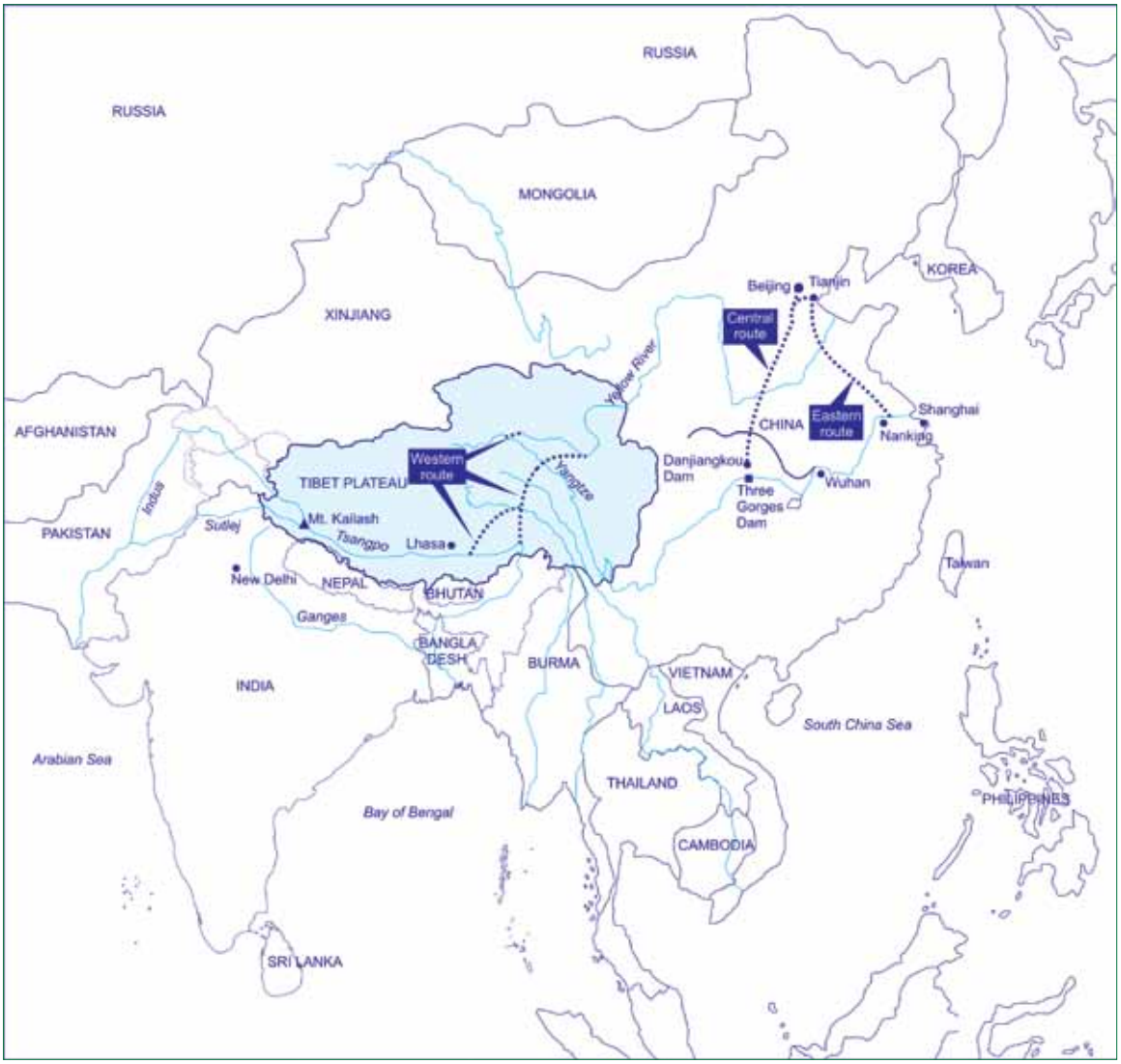
Although this trend also underscores the continuing attraction of supply-side approaches, the building of many more new dams in Asia may no longer be a viable, environmentally sustainable option to boost water supply, other than in least-developed economies such as Nepal, Burma, and Laos that have not adequately exploited their water resources. Projects designed to offer structural solutions in the form of dams, reservoirs, irrigation

Asia is the world's most dam-dotted continent, but China alone has slightly more than half of the approximately 50,000 large dams on the planet.

[1] International Commission on Large Dams, "Intranet," online data; and World Commission on Dams, "Dams and Water: Global Statistics," online data.

[2] The definition of the International Commission on Large Dams (ICOLD) has been adopted by the World Commission on Dams.

Figure 2: Most of Asia's Major Rivers Originate on the Tibetan Plateau



Note: The map also shows the three routes of China's Great South-North Water Diversion Project — the Eastern Route, the Central Route, and the Western Route centered on Tibetan waters.

canals, and levees are often at the root of intrastate and interstate disputes. Dam building often triggers grassroots opposition over displacement of residents and submergence of land. But such opposition tends to be effectively stifled in autocracies. Democracies, by contrast, struggle to get over the local resistance.

Supply-side approaches, centered on water diversion and storage, are driven by the imperative to meet growing water needs, the attraction of

hydroelectricity (whose fuel cost for production is zero), the need to address spatial imbalances in intra-country water distribution, and the effort to cushion the seasonal variability in water availability. Yet aggressively pursued supply-side approaches have often contributed to instigating water feuds between provinces or communities over perceived excessive or inadequate water channeling. And when dam building has shifted from internal rivers to international rivers, inter-country disputes and even tensions have arisen.

One trend in Asia, best epitomized by China, is toward giant dam projects. China has graduated from building large dams to constructing mega-dams. The world's largest dam, the Three Gorges Dam on the Yangtze in China, has an installed power-generating capacity of 18.3 gigawatts (GW) — almost nine times the total capacity of the 17 generators at the United States' Hoover Dam site. By contrast, the world's largest coal-fired plant is much smaller — the 4.1 GW Kendal Power Station in Mpumalanga, South Africa.

Other examples of mega-dams in China include its latest addition on the international Mekong River — the 4,200 megawatt (MW) Xiaowan, which dwarfs Paris's Eiffel Tower in height — and a proposed 38 GW dam on River Brahmaputra at Metog ("Motuo" in Chinese), close to the disputed, heavily militarized border with India. The Metog Dam will be twice as large as the Three Gorges Dam, according to HydroChina Corporation, a leading state-owned dam builder. The 5,850 MW Nuozhadu Dam, nearing completion on the Mekong, is bigger than even Xiaowan.

Internationally, the scale of dam projects increased throughout much of the 20th century as countries sought to produce more and more hydroelectricity and build a robust water-storage capacity. But the serious environmental impacts of large dams have given pause to many of their proponents and increased the attraction of small, run-of-river hydropower plants. Degraded watersheds, for example, constitute one of the most serious problems for sustainable development in Asia.

Multipurpose Run-Of-River Dams Versus Storage Dams

Dams are generally designed to serve three broad functions. One is the storage of water to offset natural fluctuations in river flows so as to meet demand in the dry season. Two is the increase of hydraulic head to help generate hydropower. And three is to provide water for irrigation, industrial, and household needs, control flooding, and improve river navigation. Essentially, there are two types of dams: Run-of-river dams, which have very limited storage and are designed primarily for power generation, and the larger storage-type, multipurpose dams.

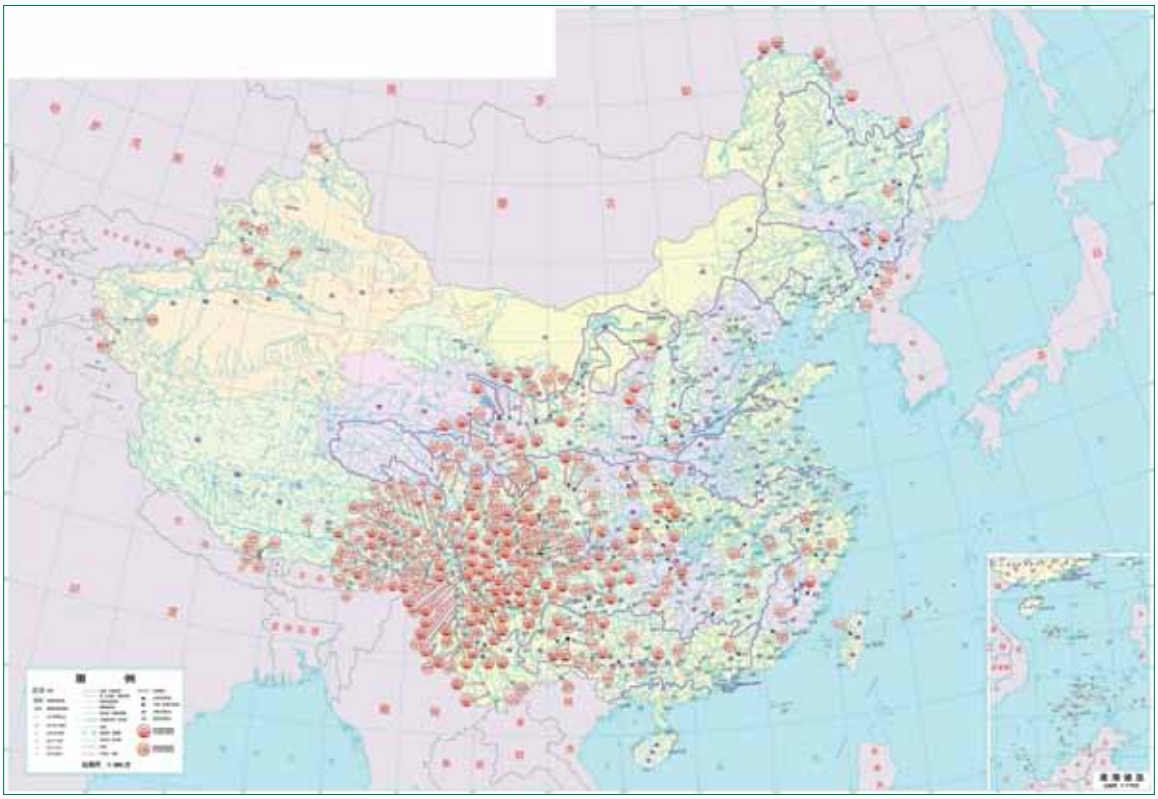
The run-of-river dams help generate power by harnessing the forces of water flow and gravity at the point where a river has a natural drop. To produce electricity, the water is allowed to flow through low head turbines housed in a weir — a small dam — with the outflow virtually the same as inflow and the water returning directly to the river without any change in the flow or water levels. As a sort of holding pond, the weir helps moderate fluctuations in water flow. The weir's small storage, however, is typically designed to provide no more than 48 hours of constant water supply. A run-of-river dam can often be built in an environmentally considerate way. Moreover, such a dam usually does not materially alter cross-border flows.

Storage dams, by contrast, usually impound enormous quantities of water because they often have a large reservoir capacity. Moreover, storage dams are often part of multipurpose projects. The dam reservoir captures water from rain and snowmelt in the spring and summer, as well as

China has graduated from building large dams to constructing mega-dams.

Storage dams usually carry significant environmental costs, yet they are more reliable and economical for power generation than run-of-river dams.

Figure 3: New Dams Planned in China, Including Mega-Dams on Transnational Rivers



Note: National borders depicted in this map are at variance with actual control.
Source: HydroChina Corp., 2010, http://www.hydrochina.com.cn/zgsd/images/ziyuan_b.gif.

directly from the river, and can serve as the first line of defense against flooding. The reservoir stores the runoff for release in the non-wet seasons. Such water releases ensure sufficient flows for irrigation, power generation, navigation, and other purposes. Storage dams usually carry significant environmental costs, yet they are more reliable and economical for power generation than run-of-river dams, whose capacity to produce electricity tends to decrease as river flows diminish in the dry season.

Most of the dams built or under construction in Asia are large storage dams. Run-of-river projects, however, are also being pursued. For example, the tiny Himalayan nation of Bhutan now boasts South Asia's highest per-capita income by exploiting its hydropower reserves with the help of run-of-river projects. Several small-scale dam projects based on the run-of-river technology have enabled Bhutan to earn substantial foreign-exchange revenues by exporting electricity to India, which helped finance the construction of those dams.

The Growing Environmental Impacts

The large-scale sequestration of river resources through dams, barrages, reservoirs, and other human-made structures, besides instigating political feuds, carries larger environmental

implications for Asia. Indeed, environmental impacts are already becoming visible on watersheds, riparian ecology, and water quality.

Heavy damming of rivers admittedly is not the only contributor to the environmental impacts. Rising prosperity in Asia, by promoting soaring consumption, has contributed to aggravating the environmental impacts of human activities. State policies have also promoted environmental degradation. Subsidies, for example, have helped weaken price signals, encouraging farmers to draw too much water from rivers and overexploit groundwater — a strategic resource that traditionally has served as a sort of drought insurance. The overexploitation of groundwater can lead to the drying up of wetlands, lakes, and streams that depend on that source of supply.

Large dams, however, are often responsible for changes in river hydrology, sediment load, riparian vegetation, patterns of stream bank erosion, migration of fish, and water temperature.

More broadly, water abstraction in excess of the renewable capacity of the hydrological cycle is affecting ecosystems and degrading water quality in large parts of Asia. Environmental degradation in the form of shrinking forests and swamps and over-damming of rivers threatens to foster a cycle of chronic flooding and droughts. Forest cover in the watersheds, after all, is critical to the maintenance of the hydrological integrity and ecological health of river systems, because it helps to control stream flows and serves as a sediment trap and river-bank stabilizer. Extensive deforestation, for example, on the Tibetan Plateau — the world's largest repository of accessible freshwater — is upsetting the water-runoff regime and reducing natural habitats and native species.

In the period since Tibet came under Chinese control in 1950-1951, much of its forest cover has disappeared or considerably thinned. Satellite pictures show the extent of the disappearance of the plateau's heavy forests, concentrated in its water-rich southern and eastern Himalayan belt, where Asia's great river systems originate. High-resolution satellite imagery drawn from the Landsat Thematic Mapper between 1990 and 2000 has underscored continuing land transformation in Tibet through conversion of forests and grasslands to cropland and other uses.[3] The problem is being compounded by "overcutting, inaccurate government reporting of forest cover, and poor land-use decisions."[4] The deforestation has extended to the Indian and Nepalese sides of the Himalayas.

Large dams, for their part, have caused sedimentation, inundation, habitat damage, destruction of fish species, and other environmental and public-health problems in Asia. Heavy damming of the Yangtze River, for example, has upset its natural tropical flooding cycle, which helps spread nutrient-rich silt collected from the mountains and is thus critical to fisheries and the refertilization of overworked soils. By blocking the natural flow of silt, the Three Gorges Dam — the world's biggest — has forced farmers in the lower Yangtze basin to increasingly rely on chemical fertilizers. In Central Asia, the Aral Sea has shrunk by more than half owing to the over-damming of its sources, the Amu Darya and Syr Darya rivers.

Multiple large dams and other upstream water diversions from river systems are causing a retreat

Large dams cause changes in river hydrology, sediment load, riparian vegetation, migratory patterns of freshwater species, and water quality.

[3] Jiyuan Liu, Hanqin Tian, Mingliang Liu, Dafang Zhuang, Jerry M. Melillo, and Zengxiang Zhang, "China's Changing Landscape during the 1990s: Large-Scale Land Transformations Estimated with Satellite Data," *Geophysical Research Letters*, Vol. 35 (2005).

[4] Jianchu Xu, R. Edward Grumbine, Arun Shrestha, Mats Eriksson, Xuefei Yang, Yun Wang, and Andreas Wilkes, "The Melting Himalayas: Cascading Effects of Climate Change on Water, Biodiversity, and Livelihoods," *Conservation Biology* Vol. 23, No. 3 (2009), p. 526.

The over-damming of rivers is causing a retreat of Asia's 11 heavily populated mega-deltas that are fed and formed by rivers originating on the Tibetan Plateau.

of Asia's 11 heavily populated mega-deltas that are fed and formed by rivers originating on the Tibetan Plateau.[5] A mega-delta is defined as having an area of more than 10,000 square kilometers. The nutrients disgorged by rivers when they drain into oceans are critical to marine life and ecology and to deltaic ecology. But with the over-damming of rivers reducing the downstream nutrient flows, Asian mega-deltas have become more vulnerable to the effects of climate change and sea-level rise. These mega-deltas — home to megacities like Bangkok, Calcutta, Dhaka, Guangzhou, Karachi, Shanghai, and Tianjin — are, in several cases, also major economic-boom zones. Meanwhile, seawater intrusion, accelerated by reckless groundwater extraction, is already affecting the availability of freshwater supplies in some coastal cities, including Jakarta, Manila, Bangkok, Dhaka, and Karachi. The very future of Bangladesh — mostly made up of alluvial lowlands at the confluence of three great rivers, the Brahmaputra, the Ganges, and the Meghna — is threatened by the ocean-level rise and the rapid incursion of saltwater, which is eating into its coastal land and affecting drinking-water supplies.

About 37 percent of the global population lives within 100 kilometers of a coastline.[6] In Asia, however, a much greater percentage of the population is concentrated along the economically booming coasts. This is best exemplified by Southeast Asia, which has 3.3 percent of the global landmass but more than 11 percent of the world's coastline. That is why an Asian Development Bank study has warned that Southeast Asia will be one of the regions in the world worst affected by the rise in sea levels.[7]

[5] R. V. Cruz, H. Harasawa, M. Lal, S. Wu, Y. Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, C. Li, and N. Huu Ninh, "Asia," in *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by M. L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (Cambridge: Cambridge University Press, 2007), Chapter 10, Section 10.6.1.

[6] Joel E. Cohen, Christopher Small, Andrew Mellinger, John Gallup, and Jeffrey Sachs, "Estimates of Coastal Populations," *Science*, Vol. 278, No. 5341 (November 14, 1997), pp. 1209-13.

[7] Asian Development Bank, *The Economics of Climate Change in Southeast Asia: A Regional Review* (Manila: Asian Development Bank, April 2009).

2 Asia's Water Crisis

Asia's growing populations, rising food and industrial production demands, and expanding municipal-supply needs have placed it on the cusp of severe water shortages. By 2025, 1.8 billion people in the world are likely to be living in conditions of *absolute water scarcity*, and two-thirds of the global population could confront *water stress*.[8] The vast majority of those facing water-related distress would be in Asia.

While Asia's freshwater resources have remained the same, its population has grown from nearly 1.5 billion in 1950 to 4.2 billion by the end of 2011, or 60 percent of the world's total.[9] Competition in Asia for water and energy resources is already intense and is set to increase because of the rapid economic development and the rise in standards of living. Asians will perforce have to make do with less water.

Asia is already the world's driest continent, with availability of freshwater less than half the global annual average of 6,380 million cubic meters (m^3) per inhabitant. Asia's rivers, lakes, and aquifers give it, per capita, barely one-tenth the water of South America or Australia and New Zealand, less than one-fourth of North America, nearly one-third of Europe, and about 25 percent less than Africa.[10] Yet the world's fastest-growing demand for water for food and industrial production and for municipal supply is also in Asia, which now serves as the locomotive of the world economy.

Water stress is greater across central, southern, southwestern, and western parts of Asia and also in the semiarid northern China. East Asia has about 23 percent of the global population but 7.9 percent of the world's freshwater resources. That ratio is worse in South Asia, which also is home to roughly 23 percent of the global population yet has just 4.1 percent of the world's water resources. In sub-state areas where water availability has traditionally been very low, even small declines or annual variations in precipitation can exacerbate the vulnerabilities of entire communities by creating drought-like conditions. The fact is that the spreading water stress in Asia holds a direct bearing on economic and social progress, as well as on environmental protection.

Today, the most-dynamic Asian economies, including China, India, South Korea, Japan, Vietnam, Thailand, and Singapore, are all in or close to being in conditions of water stress. But just three or four decades ago, these economies were relatively free of water stress. This shows how dramatically the water situation has changed in Asia ever since its economic growth took off impressively.

If we look three or four decades ahead, it is apparent that the water situation will considerably worsen in the fast-growing Asian economies as well as in countries where the total fertility rate (TFR) still remains high. For example, Pakistan's exploding population — a ticking time bomb that threatens to rip asunder what is already arguably an unmanageable, violence-plagued country — has engendered mounting water stress.[11] This is exactly the same situation in Afghanistan and Yemen. The Asian nations largely free of water stress at present are just a handful and, other than one, typically small economies: Bhutan, Brunei, Burma, Cambodia, Laos, Malaysia, and Papua New Guinea.

The fastest-growing economies in Asia are all in or close to being in conditions of water stress, raising concerns about their future trajectories.

[8] Food and Agriculture Organization, "Hot Issues: Water Scarcity," 2012.

[9] United Nations Population Division, *World Population Prospects: The 2010 Revision* (New York: UNPD, 2011).

[10] Food and Agriculture Organization, Aquastat table, "Freshwater Availability: Precipitation and Internal Renewable Water Resources (IRWR)," 2011.

[11] According to United Nations data, Pakistan's total fertility rate, or TFR, of 3.96 babies per woman is more than twice Iran's rate of 1.81.

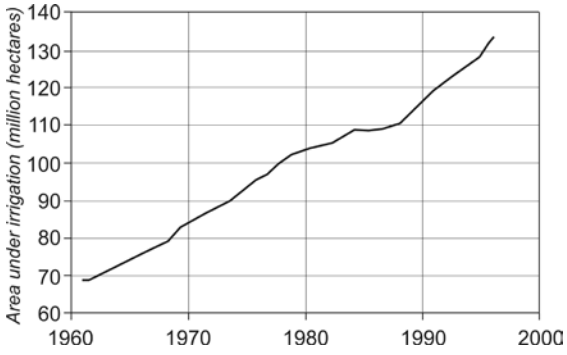
Figure 4: Freshwater Availability: Precipitation and Internal Renewable Water Resources (IRWR)

Subregions	Precipitation		Internal renewable freshwater resources		
	Depth per year (mm)	Volume per year (km^2)	Volume per year (km^2)	% of world freshwater resources	per captia (m^2)
East Asia	634	7,452	3,410	7.9	2,204
South Asia	1,602	4,755	1,766	4.1	1,128
Mainland Southeast Asia	1,872	3,629	1,783	4.1	7,929
Maritime Southeast Asia	2,740	8,270	4,707	10.9	13,171
Central Asia	273	1,270	263	0.6	3,020

Source: Data drawn from Aquastat, 2012.

One consequence of the crisis is that local resistance is building up to governmental or corporate decisions to set up water-intensive energy plants or manufacturing facilities in water-scarce areas. With industrial and food production demands putting increasing pressure on local water resources, non-governmental organizations and citizens groups have led grassroots movements in some water-stressed regions against the setting up of water-intensive industries. Such protests, especially in non-autocratic states, have delayed the plans of some corporations and thereby driven up project costs.

Figure 5: Asia Doubled its Irrigated Acreage in 40 Years



Source: Based on FAO data.

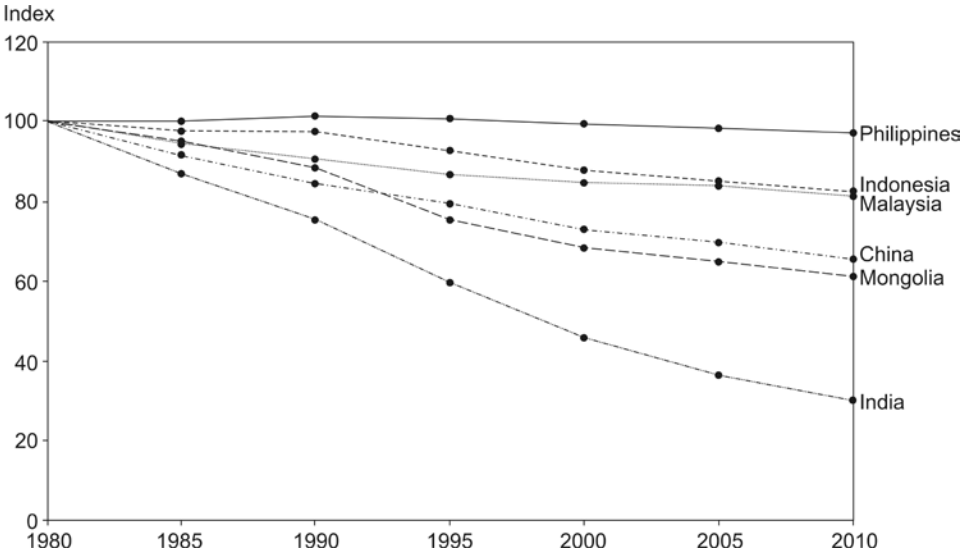
The crisis also carries significant security risks, which have been underscored by the sharpening inter-country and intra-country competition over water resources. Water has emerged as a source of increasing discord within and between nations in Asia, spurring new tensions over shared basin resources.

Crisis Seen from Different Angles

Like a prism, Asia's water crisis takes on different colors and dimensions when viewed from different angles. One angle is to look at the internal renewable water resources (IRWR) of a country or subregion, including its per capita availability. Looking at that reveals a high degree of water stress in a number of countries (or regions within nations). When water supplies come under significant pressures, this development contributes to or aggravates existing problems, such as energy shortages, environmental degradation, and social tensions.

Another angle is provided by the Index of Water Available for Development, which has been created

Figure 6: Declines in Water Availability for Development in Selected Asian Countries since 1980



Source: United Nations Economic and Social Commission for Asia and the Pacific, 2009.

by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) as a measure of per-capita water availability for human, economic, and ecological uses per year on the basis of each nation's internal renewable water resources minus total water used. This index reveals that there have been steep declines in water availability for development since the baseline year of 1980 in a number of Asian nations, including the two giants, China and India.[12] Whereas tropical Philippines — with a relatively high annual rainfall — has recorded only a marginal decrease in its water availability for development, India has registered the steepest decline.

A third angle is to examine the water withdrawal ratio (WWR), or the aggregate rate at which water is withdrawn from rivers, lakes, and aquifers as a percentage of a country's IRWR. Whereas the rate of water withdrawal for the Americas is 4 percent, Africa 5 percent, Europe 6 percent, and Oceania 3 percent, it is a high 20 percent for Asia, with the withdrawals in South Asia and Central Asia, a monstrous 56.8 percent and 61 percent of their IRWR, respectively.[13] Such WWR figures highlight the severe pressures on indigenous water resources, which in many countries are supplemented by cross-border natural inflows.

Changing the prism's angle to look at the total actual renewable water resources (ARWR) — the combined internal and external actual inflows — does not materially alter Asia's water situation. Asia actually stands out for a dubious distinction: The water withdrawals there are higher than in the rest of the world as a percentage of ARWR, which is a measure of the maximum theoretical yearly amount of water actually available.

Asia's water crisis is largely tied to its excessive water withdrawals for agriculture, necessitated by its relatively dry climate and unique, monsoon-centered rainfall patterns. Whereas Europe

Asia's water crisis is largely tied to the high water withdrawals for agriculture because of climate and rainfall patterns.

[12] United Nations Economic and Social Commission for Asia and the Pacific, *Sustainable Agriculture and Food Security in Asia and the Pacific* (Bangkok: United Nations Economic and Social Commission for Asia and the Pacific, 2009), figure III-2, p. 63.

[13] FAO, Aquastat table, "Freshwater Availability."

Asia produces — and consumes — much of the world's rice, the thirstiest grain crop.

Figure 7: World's Top Rice Exporters and Importers

Top 10 Exporters	In 1,000 tons	Top 10 Importers	In 1,000 tons
Thailand	9,047	Philippines	2,400
Vietnam	6,734	Nigeria	2,000
Pakistan	4,000	Indonesia	1,150
USA	3,856	Iraq	1,140
India	2,050	Saudi Arabia	1,069
Cambodia	1,000	Malaysia	907
Uruguay	808	Côte d'Ivoire	840
China	619	South Africa	733
Egypt	570	Bangladesh	700
Argentina	468	Japan	700

Note: Figures for 2010. European Union is not treated as a single entity and thus excluded.
Source: Data drawn from Food and Agriculture Organization and U.S. Department of Agriculture.

and North America have long rainy seasons and temperate climates, the ascendancy of the monsoons over Asia means that much of the rain there falls in a three-month period, which, in some areas, may extend to four months. The rest of the year is relatively dry, dictating heavy reliance on artificial irrigation for crop cultivation.

Rainwater is the primary source of water for agriculture in the world, other than Asia, where irrigation is the norm. Asia's yearly agricultural water withdrawals, as a proportion of its total water abstraction, aggregate to 82 percent, or at least 11 percentage points higher than the global average. The corresponding figure for Europe is just 29 percent and for North America, 38 percent.[14] Asia produces — and consumes — much of the world's rice, the thirstiest grain crop. The world's largest rice exporters are all Asian states — Thailand, Vietnam, and Pakistan, in that order — but the world's biggest rice importer is also an Asian country, the Philippines.

High agricultural water abstraction as a percentage of ARWR is actually indicative of water scarcity or water stress. The contiguous arc from Kyrgyzstan, Tajikistan, Uzbekistan, Turkmenistan, and Pakistan extending to Jordan, Israel, the Arabian Peninsula, and the Maghreb-Sahel sticks out for a troubling fact: It has the world's highest agricultural water abstraction rate, which actually exceeds the danger point — 40 percent of ARWR. India and Afghanistan, which extract 36 percent and 35 percent of their ARWR for farming respectively, risk approaching this danger threshold.[15] A nation's risks actually begin when it crosses an ARWR-related abstraction of more than 20 percent for agriculture — a category that includes South Korea and Kazakhstan. China, at 12.61 percent, is still on the safe side.

In terms of water withdrawals for all sectors — agricultural, industrial, and municipal — pressure on national water resources is considered to be high when the combined ARWR-related abstraction ratio exceeds 25 percent. That is the case in relation to several Asian economies, including India (39.82 percent), South Korea (36.54 percent), Singapore (31.67 percent), Pakistan (79.51 percent), and Kazakhstan (28.94 percent). On the positive side of the ledger are China (19.51 percent), Japan (20.93 percent), the Philippines (17.03 percent), Thailand

[14] FAOSTAT, 2012.

[15] FAO, Aquastat data, 2012.

Figure 8: Water Withdrawals in Asia

Subregions	Total withdrawl by sector						Total freshwater withdrawl km²/year	Freshwater withdrawal as % of IRWR
	Municipal		Industrial		Agricultural			
	km²/ year	%	km²/ year	%	km²/ year	%		
East Asia	93.4	14	149.8	22	434.2	54	577.4	19.9
South Asia	69.9	7	19.5	2	914.1	91	1,003.6	56.8
Mainland Southeast Asia	8.9	5	20.4	12	139.8	83	169.0	9.5
Maritime Southeast Asia	14.1	8	10.1	6	146.9	86	171.0	3.6
Central Asia	5.0	3	8.0	5	150.0	92	162.0	61.0

Source: Data drawn from Aquastat, 2012.

(13.07 percent), Vietnam (9.28 percent), and Malaysia (2.28 percent).

Why Water Quality Matters

Ratios can be deceptive if they do not factor in water quality. As with the other yardsticks, the ARWR values, for example, reflect only the quantity of available water resources within a country. But when the quality of available resources is poor, the overall quantity can hardly reveal the true story.

That explains why China — despite an aggregate ARWR ratio of 19.51 percent, which is well below the danger mark — is chronically unable to meet its water needs. Yet Japan, with a slightly higher ratio but better water quality than China, is managing its water requirements well. The Chinese vice minister of water resources acknowledged in October 2011 that the country's improvident style of economic growth has left up to 40 percent of its river waters badly contaminated. The Yellow River, the cradle of the Chinese civilization, is now so polluted that it no longer is the source of drinking water.

In truth, water shortages can be better managed when a nation maintains water quality or makes concrete progress to improve quality. For example, densely populated South Korea and Pakistan are both water-stressed, with limited water resources and an identical per-capita availability of freshwater — about 1,450 m^3 per year.[16] Yet the world hears about Pakistan's water crisis but not about South Korea's. Thanks to its improved water quality and productivity, South Korea — despite its vulnerability to recurrent drought — does not face the serious crisis situation haunting Pakistan. In startling contrast, Pakistan has done little to arrest the rapid deterioration of its water quality, with intensive irrigation a major contributor to its growing problems of soil salinity and water pollution.

Compounding the water challenges is the fact that Asia has one of the lowest levels of water efficiency and productivity in the world. This only underlines the importance for Asia of water conservation and recycling, improved water quality, as well as efficiency and productivity gains. Reducing national water footprints through improvements in water quality and water-efficiency use can go a long

[16] FAOSTAT, 2012.

Water shortages can be better managed when a nation maintains water quality or makes progress to improve quality.

Only 4 of the 57 international river basins in Asia have a water-sharing or cooperative treaty.

way in ensuring that any state's future economic growth and environmental sustainability are not compromised.

Absence of Conflict-Prevention Mechanisms

Water shortages in Asia are beginning to strain inter-riparian relations. These strains are occurring between nations, as well as within nations in the form of inter-provincial water feuds.

In the inter-country context, the absence of legally binding arrangements for water sharing and institutionalized cooperation in most of the 57 transnational river basins in Asia is a cause for concern. Only 4 of these 57 basins have a water-sharing or cooperative treaty. These are the Mekong, Ganges, Indus, and Jordan River basins. The non-participation of the dominant upper riparian China in the Mekong arrangement has seriously encumbered norm- and institution-building in that basin.

The absence of institutionalized cooperation characterizing the vast majority of transnational basins in Asia only highlights the geopolitical risks. These risks have to be seen in the context of the water discord in many basins and the broader absence of an Asian security architecture. Asia is the only continent other than Africa where regional integration has yet to take hold, largely because Asian political and cultural diversity has hindered institution-building. Managing the water competition in Asia is thus becoming an increasingly important challenge.

Ominously, water-rich areas are at the center of geopolitical tensions in Asia. They range from Kashmir and Tibet to the Golan Heights and the West Bank. These areas, in addition to their water wealth, are strategically located. Another such region is the Fergana Valley, whose control is divided among Kyrgyzstan (which holds almost two-thirds), Uzbekistan, and Tajikistan. The ethnic fault lines that run through the Fergana Valley are the source of periodic ethnic clashes among the Kyrgyz, Tajiks, and Uzbeks. Kashmir is similarly split among India, Pakistan, and China. India controls 45 percent of the original princely state of Jammu and Kashmir, Pakistan 35 percent, and China the remaining 20 percent.

Like other water-rich regions, Kashmir is a key crossroads in the regional geopolitical rivalry. But while Tibet has come firmly under China's rule, and the Golan Heights (the source of Jordan River's headwaters) and the aquifer-controlling West Bank were captured by Israel in the 1967 Six-Day War, Kashmir remains a divided and contested territory, like the Fergana Valley. For the foreseeable future, however, all the water-rich areas are likely to stay potential flashpoints for water wars because they seem ripe for further geopolitical jousting.

3 The Great Himalayan Dam-Building Competition

The mighty Himalayas and the adjacent Karakoram, Kunlun, Hindu-Kush, Pamir, and Tian Shan ranges, with their countless glaciers, mountain springs, and lakes, are endowed with the world's greatest water reserves. Together, these areas constitute the Great Himalayan Watershed, encompassing the water-rich southern and southeastern Tibetan Plateau that extends to Yunnan and Sichuan, the Himalayan regions in Burma, India, Bhutan, Nepal, and Pakistan-held Kashmir, and the upper catchment areas in Afghanistan, Tajikistan, and Kyrgyzstan. Given its unmatched water resources, the Great Himalayan Watershed is the focal point of Asian dam-building.

In this larger region, the Tibetan Plateau — the world's highest and largest plateau, stretching 2,400 kilometers from east to west, and 1,448 kilometers from north to south — is a water bank without comparison. It is Asia's main freshwater repository and largest water supplier. Just as the Alps are the source of Europe's large rivers, the Tibetan-cum-Himalayan region is the starting point for all of Asia's great rivers.

The Tibetan-cum-Himalayan region, however, is a watershed on a much bigger scale, with no equivalent elsewhere in the world. It is the water provider to much of Asia, especially its most heavily populated regions. Ten great river systems, and countless streams, originate on the Himalayan and Tibetan highlands, spreading river waters from mainland China, through continental Southeast Asia and the Indian subcontinent, to Central Asia. The countries in this arc contain nearly half of the global population.[17]

Most of the new dams and other water diversions in Tajikistan, Kyrgyzstan, Pakistan, Tibet, Nepal, India, Bhutan, Burma, and Laos are concentrated in the Great Himalayan Watershed. In fact, two-thirds of China's hydropower potential is located on the Tibetan Plateau, including the so-called Tibet Autonomous Region (TAR) and the Tibetan areas in Yunnan and Sichuan provinces. The Great Himalayan Watershed, with the world's third largest ice mass after the Arctic and Antarctic regions, is probably the "most critical region" in terms of the likely impact of the global-warming-induced accelerated glacial thaw on water supplies.[18]

Because the ice cores, the freshwater resources, and the sources of some of the world's greatest rivers are largely located in the Himalayan belt where international borders converge, national water projects are also heavily concentrated there, raising larger political and environmental concerns. This is also the belt where there are disputed and militarized borders, such as between China and India, between Pakistan and India, and between Pakistan and Afghanistan.

The "dam racing" in this region thus raises important geopolitical concerns. The various riparian states in this extended watershed are seeking to appropriate the resources of shared rivers without considering the impacts of their water-harnessing plans on hydrologic stability and environmental security. The rival dam-building plans have engendered mutual misgivings. Even when an understanding or accord on shared water resources exists, its faithful implementation tends to be questioned by one or both parties.

In the broader Himalayan region, "tensions between countries over the proper management

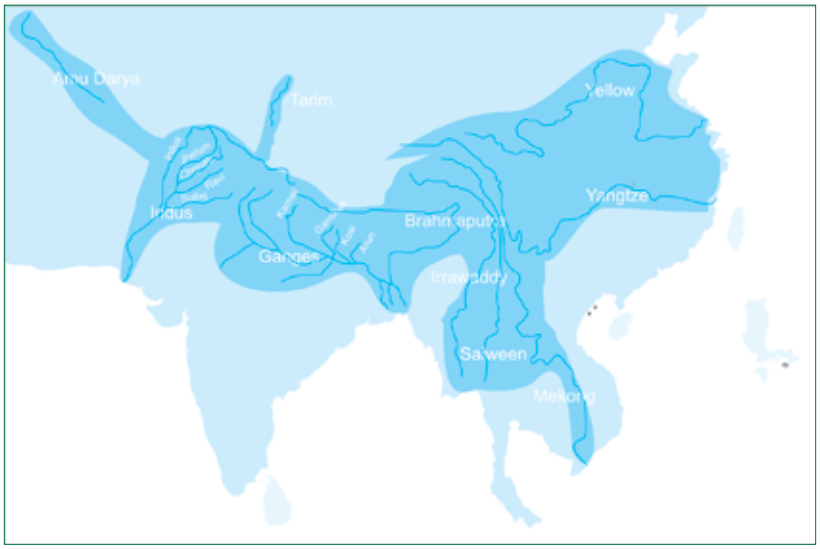
The world's greatest freshwater resources are concentrated in the Himalayas and the Tibetan highlands, where the dam-building competition is concentrated.

[17] Based on 2011 estimates in United Nations, *World Population Prospects: The 2010 Revision* (New York: United Nations Population Division, Department of Economic and Social Affairs, 2011).

[18] T. P. Barnett, J. C. Adam, and D. P. Lettenmaier, "Potential Impacts of a Warming Climate on Water Availability in Snow-Dominated Regions," *Nature*, No. 438 (November 17, 2005), p. 306.

China has a natural advantage over other countries because almost all the major Asian rivers originate on the Tibetan Plateau.

Figure 9: Rivers Originating in the Great Himalayan Range and Adjoining Mountains



and equitable allocation of water resources mean that the potential for international conflict is high."[19] China's multiple dam projects in the Great Himalayan Watershed, including the Brahmaputra and Arun river basins, have, for example, prompted India to initiate its own dam-building program in the Himalayas. China and India are not only competing to build dams along their disputed high-altitude frontier, but also are aiding other states' plans to tap river resources in the Great Himalayan Watershed.

While Chinese firms are involved in dam building in Pakistan-controlled Kashmir, Nepal, and Myanmar, India is aiding some Bhutanese and Nepalese dam projects. In Pakistan-held Kashmir, China has even deployed several thousand of its own troops at the sites of dams and other strategic projects. These troops are said to belong to the engineering corps of the People's Liberation Army. The presence of Chinese troops in the Pakistani part of Kashmir, even if in the form of construction battalions, means that there are Chinese troops on both flanks (east and west) of Indian Kashmir — a development that underpins the Sino-Pakistan strategic nexus against India in a nuclearized geopolitical triangle.

China, whose major dam-building activities have increasingly moved to the Tibetan Plateau, has a hydrological and strategic advantage over other countries in the Great Himalayan Watershed because almost all the major Asian rivers originate on its side of the highlands. The rivers include the Yangtze, the Yellow, the Mekong, the Salween, the Irrawaddy, the Arun, the Brahmaputra, the Karnali, and the Indus. Two key Central Asian rivers — the Amu Darya and the Tarim — rise in the western rim of this watershed.

The Ganges is the only great Asian river that rises on the Indian side of the Himalayan rim. But whereas the Ganges' primary source — the Gangotri Glacier — and point of origin are on the Indian side of the Himalayas, this mighty river's main tributaries flow in from the Chinese-controlled Himalayan areas. These tributaries include the Karnali, the Gandak, and the Kosi (whose uppermost part is called the Arun). These actually are Nepal's principal river systems, and they drain into the Ganges in India.

The Himalayan and Tibetan highlands play a central role in the Asian monsoons, which cover a vast region extending from the Korean Peninsula to the Arabian Sea. These highlands help shape

[19] Gwyn Rees (ed.), *Hindu Kush-Himalayan FRIEND 2000–2003* (Paris: International Hydrological Program of UNESCO, 2004), p. ix.

climatic and rainfall patterns in multiple ways. In the summer, the Tibet Plateau's rocky and lofty terrain heats up quickly to form a low-pressure system that helps attract monsoonal currents from the east, southeast, and southwest — that is, from the East and South China Seas, the Bay of Bengal, the Indian Ocean, and the Arabian Sea. By acting as a high-elevation heat pump, this region helps make rain.

Whereas the Tibetan Plateau serves as the heat pump, the Himalayas — with their unparalleled height — trap the monsoonal currents in their midst, generating heavy precipitation in the Great Himalayan Watershed. This, in turn, boosts the water-storing capacity of the Himalayan glaciers, which number more than 18,000 if only the large ones are counted.

Because the Himalayas obstruct the northward advance of the summer monsoons, the richest water resources are located in Tibet's border belt with India, Nepal, and Bhutan. This natural reality has also influenced the evolution of lakes, with a general increase found in the salinity of lakes as one goes from the Tibetan Plateau's water-rich southern and southeastern belt to its arid northern and northwestern areas.[20] The Himalayas help deflect part of the precipitation system in an eastward direction, with the result that the regions to the east in southern China and Southeast Asia also get good rainfall.

Chinese experts have estimated that there are about 15,000 large glaciers just in the Himalayan region of China; if the smaller glaciers are also counted, that figure jumps to 36,793.[21] The Himalayan portion in Tibet has at least three times more glacier area than the part in India. Indeed, other than some glaciers in Xinjiang, China's glaciers are all concentrated on the Tibetan Plateau, including the areas that have been taken out of Tibet and either merged with Sichuan, Gansu, and Yunnan or turned into the separate province of Qinghai. China actually has renamed the Tibetan Plateau the "Qinghai-Tibetan Plateau."

The Vulnerability of Asia's "Water Tower"

The concentration of dams and other water-diversion structures in the Himalayan and Tibetan highlands — Asia's "water tower" — raises serious concerns about the impact of these projects on what is one of the world's most ecologically sensitive regions. With its exceptionally high topography, fragile ecosystems, and endangered endemic species, the Tibetan-cum-Himalayan region is more susceptible to the adverse effects of global warming than any other part of the world.

The Himalayan and Tibetan highlands, constituting one of the world's most biodiverse regions, are both a driver and an amplifier of global warming.[22] Climate change and human-made environmental change, in fact, threaten the integrity of the glaciers, lakes, underground springs, and permafrost that have endowed these highlands with the world's greatest river systems. Human activities, ranging from dam building to demographic changes, are endangering this unique region.

Several studies have highlighted the accelerated glacier thawing in these highlands. According to one study by Chinese experts, Tibetan glacier thawing in the 1990s alone resulted in a 5.5 percent

The concentration of dams in Asia's "water tower" raises concerns about their impact on an ecologically sensitive region.

[20] Mianping Zheng, *An Introduction to Saline Lakes on the Qinghai-Tibet Plateau* (Berlin: Springer, 1997), p. 55.

[21] Y. Ding, S. Liu, J. Li, and D. Shangguan, "The Retreat of Glaciers in Response to Recent Climate Warming in Western China," *Annals of Glaciology* Vol. 43, No. 1 (2006), pp. 97-105.

[22] Hong Xie, Jiansheng Ye, Xiuming Liu, and E. Chongyi, "Warming and Drying Trends on the Tibetan Plateau," *Theoretical and Applied Climatology* (September 2009).

The majority of the world's endangered rivers originate in the Himalayan and Tibetan highlands.

increase in river runoff in northwestern China.[23] Qinghai Province's Three-River Headwaters Office reported in 2011 that the glaciers located in the area where the Yangtze, Yellow, and Mekong rivers originate are melting faster than the glaciers elsewhere on the Tibetan Plateau.[24]

The Himalayan and Tibetan highlands are also experiencing land erosion, degradation of their vegetated riparian buffer zones, deterioration in watershed quality, and water pollution problems. Because of their extremely high elevation, they are warming faster and earlier than the surrounding lowlands. In addition to the anthropogenic causes, a key factor behind this accelerated warming is climate change, to which China is contributing through its emergence as the world's largest carbon emitter. The average annual temperature in Tibet, in fact, is rising at a faster rate than in China and the world — a development that will have a significant impact on climatic stability across Asia.

Against that background, it is hardly a surprise that the largest concentration of endangered river systems in the world is in this part of the world. Of the world's top ten endangered rivers, five originate in the Himalayan and Tibetan highlands — the Yangtze, the Indus, the Mekong, the Salween, and the Ganges.[25] In addition, the overstressed Yellow (which also starts from the Tibetan Plateau) is widely seen as having been ecologically damaged through over-damming and heavy pollution.

More fundamentally, the greater the dependence of a river system on glacial meltwaters for sustaining its flows, the greater is its vulnerability to the effects of climate and environmental change. The Yellow and the Yangtze basins, for instance, contain limited glaciated area, but the opposite is true of the Brahmaputra and the Indus, both of which flow extensively through high-altitude terrain along the Himalayas.

The late-spring and summer discharges of the Brahmaputra and the Indus are likely to reduce "considerably" between 2046 and 2065, according to one study, "after a period of increased flows due to accelerated glacier melt."[26] Such flow reduction will pose a serious threat to economic security and social stability in their downstream basins.

The Brahmaputra is the single largest source of freshwater for Bangladesh, which heavily depends on cross-border inflows. Bangladesh indeed is likely to bear the brunt of climate change because of its low-lying position and lack of money and technology to protect itself. More than half of Bangladesh's transboundary water supplies, totaling 1,106 billion m^3 per year, are delivered by the Brahmaputra alone.[27]

The dependence of the Indus — Pakistan's critical lifeline — on flows generated by snow and glacier melt is easily the highest of any major Asian river, making it particularly vulnerable to shifts in melt characteristics fostered by climate change.[28] To make matters worse, the overstressed Indus also ranks number one in terms of vulnerability arising

[23] Tandong Yao, Youqing Wang, Shiying Liu, Jianchen Pu, Yongping Shen, and Anxin Lu, "Recent Glacial Retreat in High Asia in China and its Impact on Water Resource in Northwest China," *Science in China*, *Series D: Earth Sciences*, Vol. 47, No. 12 (December, 2004), p. 1065.

[24] Xinhua, "Glaciers on China's Qinghai-Tibet Plateau Melting Fast Due to Global Warming," October 21, 2011.

[25] World Wide Fund for Nature, *World's Top 10 Rivers at Risk* (Gland, Switzerland: WWF International, 2007).

[26] Walter W. Immerzeel, Ludovicus P. H. van Beek, and Marc F. P. Bierkens, "Climate Change Will Affect the Asian Water Towers," *Science*, Vol. 328, No. 5983 (June 11, 2010), pp. 1384-85.

[27] Food and Agriculture Organization, *Country Profile: Bangladesh*, 2010, Aquastat database.

[28] Immerzeel, van Beek, and Bierkens, "Climate Change Will Affect the Asian Water Towers," pp. 1382-85.

from the difference between basin precipitation and net irrigation demand. Pakistan, a largely semiarid country, has tapped the Indus to establish what it hails as "the world's largest contiguous irrigation networks." This extensive irrigation system has greatly contributed to Pakistan's water and environmental stresses.

The plain fact is that sustainably managing the natural resources in the Great Himalayan Watershed is critical to Asia's long-term economic growth, social stability, and ecological security. The dam-building competition only puts the spotlight on that imperative.

4 Political Discord and Grassroots Protests over Dam Projects

The building of big dams has run into public opposition in deeply rooted Asian democracies.

The absence of water-sharing arrangements in many basins, along with weak consultative mechanisms even in the few basins governed by a treaty, has encouraged unilateralism in water-development plans. However, riparian unilateralism in the form of dam building on shared rivers often carries political and environmental costs, and impedes broader regional cooperation and integration.

With Asia becoming the scene of increasingly fierce water competition, unilateralist moves are only raising the political and economic risks. At times, even foreign direct investment in forest real estate (such as the flow of Chinese money to buy mountains and forests in Japan) has triggered national suspicions that the motive may be to control streams and other sources of water.

Water indeed is a new arena in the Asian Great Game. Across large parts of Asia, the risk of water becoming a trigger for conflict or diplomatic strong-arming is high. Without a willingness to accept a cooperative approach on shared resources, there is considerable potential for aggravated water competition in Asia, especially because of the wide geographical extent of transnational basin resources and the festering territorial and resource disputes.

Grassroots Protests over Dams Flare

Because of grassroots empowerment, the building of big dams has run into public opposition in deeply rooted Asian democracies. Popular opposition, for example, led to a two-year freeze of the $5.62-billion Yanba Dam project in Japan before it was resurrected by the government at the end of 2011, although the ruling Democratic Party of Japan (DPJ) had labeled the project in its election manifesto as a "wasteful public-works scheme." The Yanba Dam originally was conceived six decades ago. Despite the project's resurrection, it is uncertain if and when it will be completed. The Yanba Dam — Japan's largest dam-construction project by value — is designed to combat Agatsuma River flooding and supply drinking water to Tokyo and surrounding areas through a reservoir designed to have a storage capacity of 107.5 million m^3.

In another democracy, South Korea, the so-called Four Major Rivers Restoration Project, launched by President Lee Myung-bak in early 2009, has proven a nationally divisive issue. The project has involved the building of more dams and barrages in a country that already boasts more than 800 large dams and 18,000 small irrigation reservoirs, with artificial lakes making up almost 95 percent of all the lakes in South Korea.

The project's high price tag — it will cost the taxpayers almost $20 billion — has also fueled public controversies. The project was originally centered on the country's four main rivers — the Han, the Nag Dong, the Kuem, and the Young San — but, on second thought, the southern Seom Jin River was also added. The Lee Myung-bak administration has brushed aside public concerns and proceeded to rapidly complete the project.

In a large raucous democracy like India, such is the power of non-government organizations and citizens groups to organize grassroots protests that it has now become virtually impossible to build a large dam, blighting the promise of hydropower. Proof of this was the Indian government's decision in 2010 to abandon three dam projects on River Bhagirathi — a Ganges tributary — including one project already underway. That project, the Loharinag Pala Dam, was scrapped on environmental grounds after authorities had already spent $139 million at the project site and ordered equipment worth $288 million. The decision represented a major loss of taxpayer money.

The largest dam India has constructed since independence is the 2,000 MW Tehri, which pales in comparison to the giant Chinese projects. The 1,450 MW Narmada Dam in west-central India has been under construction for decades. Aimed at bringing irrigation, drinking water, and electricity to millions of people in four Indian states, the project has sparked an unending war between environmental groups, human rights activists, and advocates for the displaced on the one side and federal and state authorities on the other side.

Like Japan's Yanba Dam, the Indian plan to harness the 1,300-kilometer-long Narmada River dates back to the 1940s. The various hurdles faced by the Narmada project reflect the true constraints on building any large dam in a country as politically diverse and open as India. More recently, local protests have slowed government plans to start building the 2,000-megawatt Lower Subansiri Station and 2,700-megawatt Lower Siang Station — both in the Brahmaputra River basin in the remote northeastern Indian state of Arunachal Pradesh, a territory to which China has aggressively revived its claim. The resurrection of the Chinese claim since 2006 has led India to deploy tens of thousands of more troops in Arunachal Pradesh and fortify its defenses against the well-entrenched Chinese forces across the border.

In Southeast Asia, dam-building disputes fall in two categories. First, there is political discord between the lower-riparian states and China over the unilateral Chinese harnessing of the resources of the Mekong, with the smaller and weaker states located downriver unable to persuade Beijing to halt or even slow its construction of dams on that river. Second, dam building in the lower basin — although on a much-smaller scale than by China — has also stoked public controversies and protests.

The 4,880-kilometer Mekong — the world's 12th-longest river but with the 8th-biggest annual discharge — flows from the Tibetan Plateau into Laos, Thailand, Cambodia, and Vietnam, besides forming part of Myanmar's borders with China and Laos, and Thailand's frontier with Laos. Seeking to emulate the example set by China — which is completing a cascade of big dams just before the Mekong enters Southeast Asia — Laos and Cambodia have set out to construct dams either on the Mekong or its tributaries.

Laos has drawn up an ambitious but controversial dam-building program to turn "water into white gold" by building dams and exporting hydroelectricity, largely to China. "Powering Progress" is its official catchphrase to earn hydro dollars. Indeed, most of the planned Laotian and Cambodian dams involve Chinese financial, design, or engineering assistance. Thailand's own hydro-development plans have further muddied the picture.

Laos has set a target to secure 20 percent of its GDP from hydropower and mineral exports by 2020, up from a mere 4 percent in 2011. Some of the Laotian projects, however, hold transboundary implications, especially the large 1,260 MW Sayabouly Dam. Laos, responding to growing regional concerns about the project's potential environmental and social impacts, agreed in 2011 to defer building the multibillion-dollar Sayabouly Dam until an expert review has been completed.

The fact is, more than 80 dam and other water projects have been launched or planned on the Mekong and its tributaries in both China's Yunnan Province and the lower basin. Some of the downstream projects have spurred public controversies, environmental concerns, and inter-riparian unease. Vietnam has the most to lose.

Vietnam, a rice bowl of Asia, is the farthest downstream country on both the Mekong — the main river in southern Vietnam — and on the Red

Dam building in the Mekong Basin has stoked public controversies and protests.

River, which originates on the southeastern edge of the Tibetan Plateau and flows through northern Vietnam. The Intergovernmental Panel on Climate Change (IPCC) has identified the Mekong Delta — where nearly half of Vietnam's rice is grown — as one of the world's three "hot spots," extremely vulnerable to climate change and major shifts in hydrology and water quality.[29]

China currently is implementing the Great South-to-North Water Diversion Project — the biggest hydraulic project ever designed in the world.

If all the planned Laotian, Cambodian, and Thai dams are built, they would generate 13.5 GW of electricity but have an adverse impact on the fluvial ecosystem. They could also endanger freshwater species such as the Mekong giant catfish, which is the size of a car, and the Mekong stingray, which can weigh more than a tiger. After Latin America's Amazon River, the Mekong is believed to be the world's most biodiverse inland waterway, with an estimated 1,245 vertebrate species found in its waters. Today, the overexploitation of the Mekong's resources and frenetic dam building are threatening the river system's natural hydrology.

In Myanmar, a powerful backlash against a Chinese project on Burmese territory prompted the government in the fall of 2011 to scrap a contract with China for the $3.6 billion Myitsone Dam — the biggest of the seven dam projects in northern Myanmar sponsored by China to generate electricity for export to its own market, even as much of Burma suffers from long daily power outages. The 3.6 GW Myitsone Dam was also the biggest hydropower project in the entire Southeast Asian region.

This dam project, located at the headwaters of the Irrawaddy River — Burma's lifeline — had been hailed in an August 2011by the State-Owned Assets Supervision and Administration Commission of China's State Council report as a model of party-led overseas expansion in pursuit of Chinese interests. The project's suspension, so as to help stem a groundswell of anger in Myanmar's ethnic-minority north, thus represented a blow for China but a victory for local communities, which had battled to protect their livelihoods and environment.

Despite the Myitsone setback, China remains the world's biggest dam builder at home and abroad. It has not shied away from building dams in disputed regions, such as the restive, Shiite-majority region of Gilgit-Baltistan in Pakistan-controlled Kashmir, where local resistance to Chinese dam projects has prompted the Pakistani military to enforce a security clampdown.

Within China, the social costs of the over-damming of rivers and the pursuit of inter-river and inter-basin water transfer projects have been high. This fact was reflected in Chinese Prime Minister Wen Jiabao's stunning admission in 2007 that, since 1949, China has relocated a total of 22.9 million Chinese to make way for dam and other water projects — a figure larger than the population of Australia.30

China currently is implementing the Great South-to-North Water Diversion Project — the biggest hydraulic project ever designed in the world. This project aims to stem the growing gap between water supply and demand in China's north by transferring water from the water-rich south. China's State Council thus far has approved a total budget of $62 billion for the project, designed to create three new waterways to run along the east, center, and southwest of China.

[29] Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2007: Impacts, Adaptation and Vulnerability*, Working Group II Contribution to the Fourth Assessment Report of the IPCC (New York: Cambridge University Press, 2007), p. 327.

[30] The disclosure was contained in the Premier's report to the National People's Congress. Mara Hvistendahl, "China's Three Gorges Dam: An Environmental Catastrophe?" *Scientific American*, March 25, 2008.

Like the Three Gorges Dam — the world's largest hydropower producer, which Beijing trumpets as an engineering wonder — the Great South-North Water Diversion Project harks back to the glory of imperial China, as symbolized by the Grand Canal and the Great Wall. Once it is completed, the Great South-North Water Diversion Project will replace the Three Gorges Dam as the crown jewel of China's vast water infrastructure. A key question is: Will its social and environmental costs also surpass those of the Three Gorges Dam?

In the largest eviction of residents for a single water project in modern world history, the Chinese government quelled grassroots resistance and forced 1.4 million people to leave their homes to make way for the Three Gorges Dam. The displaced were mostly evicted over a 10-year period and resettled in other parts of Chongqing Province or in nearby Hubei Province. But after being commissioned, the Three Gorges Dam has turned into an environmental nightmare, with the impoundment of massive volumes of water in its reservoir triggering landslides in the surrounding areas. To deal with the land erosion and hydrological instability, authorities in 2010 initiated a drive to evict 300,000 additional residents. So, by official count, the number of residents displaced by the Three Gorges Dam will aggregate to 1.7 million.

China's second-largest eviction drive thus far centers on the Great South-North Water Diversion Project, whose Eastern Route is largely ready. The third leg (the Western Route) is expected to begin post-2014 after the completion of the Central Route. Authorities have not disclosed the total number of people likely to be displaced by this Olympian-scale project. But to facilitate the completion of the Central Route, the relocation of about 440,000 residents — living mainly in Henan and Hubei provinces — started in 2010.[31]

The Eastern and Central Routes, even if viewed together, pale in comparison to the monumental Western Route, aimed at diverting river waters cascading from the Tibetan highlands. The Western Route comprises two component programs. The smaller program involves construction of some 300 kilometers of tunnels or channels to reroute waters northward to the Yellow River from the Jinsha (a major Yangtze tributary) as well as the less-important Ngyagchu (Yalong in Chinese) and Gyarong Ngulchu (Dadu He to the Chinese) rivers, located on the Tibetan Plateau's eastern rim.

Its larger component program (often called the "Great Western Route") aims to tap the waters of the three major international rivers on the Tibetan Plateau — the Brahmaputra, the Salween, and the Mekong — by building a series of canals and tunnels along a 1,215-kilometer path that will link up with the upper portion of the Yellow. Because the Great Western Route seeks to divert waters from rivers flowing to other countries, it is fraught with major international implications. The Chinese government thus avoids publicly discussing this route. However, an officially blessed book, provocatively titled *Tibet's Waters Will Save China*, came out in 2005 in support of this route and the proposed inter-river water transfers from the Tibetan Plateau.[32]

In fact, with power demand continuing to surge in its coastal east, China in 2000 launched a policy known as "sending electricity from west

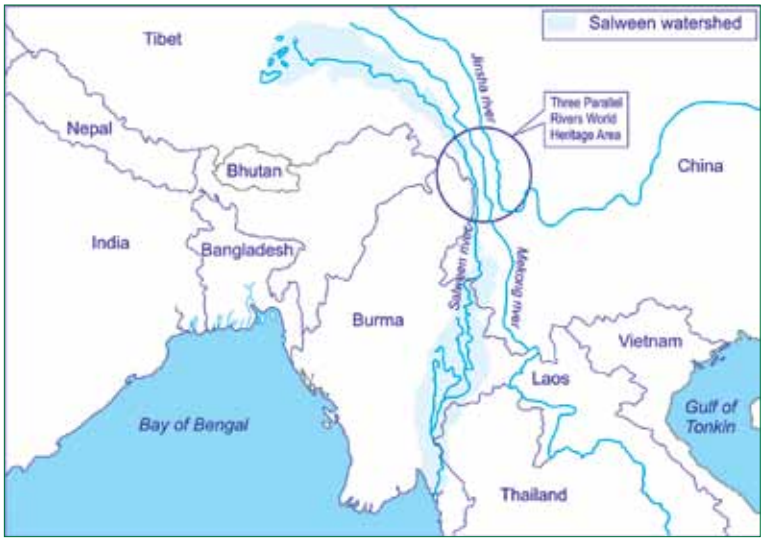
The proposed "Great Western Route" is to tap the waters of the Brahmaputra, the Salween, and the Mekong.

[31] Kang Juan, "Water Project Leads to Mass Relocation," *Global Times*, February 24, 2010.

[32] Li Ling, *Xizang Zhi Shui Jiu Zhongguo: Da Xi Xian Zai Zao Zhongguo Zhan Lue Nei Mu Xiang Lu* (Tibet's Waters Will Save China), in Mandarin (Beijing: Zhongguo chang'an chu ban she, 2005), book sponsored by the Ministry of Water Resources.

In post-Soviet Central Asia, rising nationalism and competition over water resources has impeded the development of a regional alternative to the old water-resource management system of the Soviet era.

Figure 10: Dam Building on the Salween River in the Three Parallel Rivers World Heritage Area



to east" and began approving the construction of new dams on transnational rivers on the Tibetan Plateau, including the areas that have been merged with Yunnan and Sichuan provinces. That policy signaled a shift in Chinese dam-building activities from the dam-saturated internal rivers to the international rivers in the ethnic-minority homelands, including Tibet, Xinjiang, and Inner Mongolia.

China's dam-building zeal has armed the state-run hydropower industry with growing clout in policymaking. Indeed, such is the rising influence of state-owned corporate behemoths that it was HydroChina Corporation that in 2010 revealed government plans for new mega-dams on international rivers. Until 2002, HydroChina Corporation was a government agency by the name of "Administration of Water Resources and Hydropower Planning and Design," or AWRHPD. The hydropower industry — with Sinohydro, HydroChina, China Power Investment, Gezhouba, and China Three Gorges Corporation in the vanguard — has prodded Beijing to restart suspended projects at home on the Salween River, next to the Three Parallel Rivers World Heritage Area, and to campaign aggressively for overseas dam projects by offering low-interest loans to other governments.

The Broader Political Disputes

The dam-building disputes in Asia center on four distinct zones: between China and its neighbors; between India and its neighbors; among the countries of continental Southeast Asia; and among the five so-called "stans" of Central Asia — Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan, and Turkmenistan.

In post-Soviet Central Asia, rising nationalism and competition over water resources has impeded the development of a regional alternative to the old water-resource management system of the Soviet era, when water, energy, and agriculture were integrated under a federally run and highly centralized regional system. The Soviet Union's collapse turned what had been intra-country river basins into international basins. Worse still, water sharing between the five independent "stans" that emerged has been compounded by their anomalous frontiers, which bear little resemblance to the natural or ethnic fault lines.

The introduction of intensive irrigation in the largely arid Central Asia during the Soviet period has contributed significantly to the depletion and degradation of water resources. Central Asia remains a major cotton-producing area, with the curse of cotton leading to the degradation of water and land resources in Uzbekistan, Turkmenistan, and Tajikistan.

The regional water competition today pits the interests of the two smallest and energy-poor states — Kyrgyzstan and Tajikistan, which are the sources of the Amu Darya and the Syr Darya rivers — against those of the larger, militarily stronger countries that are the main water consumers — Uzbekistan, Kazakhstan, and Turkmenistan. These three hydrocarbon-rich countries not only use the bulk of the region's water resources — estimated at 263 billion cubic m^3 per year — but also insist that their leonine share is protected under the doctrine of prior appropriation (which is discussed in the next section).

Uzbekistan, which has 45 percent of the Central Asian population and consumes more than half the region's water supply, has been embroiled in bitter water rows with upstream Tajikistan and Kyrgyzstan over their dam-building plans to boost energy production. Tajikistan and Kyrgyzstan contend such dam building is imperative because the dominant water-consuming states located downstream are unwilling to supply them hydrocarbons at concessional rates, as was the practice in the Soviet era.

In fact, Tajikistan and Kyrgyzstan desire to become renewable-energy exporters by building large new hydroelectric stations, whose proposed construction has become a flashpoint issue in the region. Uzbekistan has even held out implicit military threats against Tajikistan's plans to resume work on unfinished Soviet-era hydropower projects, including one on the Vakhsh River that was intended to be the world's highest dam.

The regional water competition is also loaded with ethnic-rivalry dimensions. The intersection between ethnic identity and water insecurity in Central Asia has fostered deep-seated ill will among communities and occasionally even spawned violent conflict. Indeed, one of the underlying causes of the mid-2010 bloody riots in the Fergana Valley that left hundreds of Uzbeks dead was the local ethnic-Kyrgyz fear that Uzbekistan wanted to absorb that water-rich region of Kyrgyzstan.

The shift in China's dam-building focus from internal rivers to international rivers carries broader political and environmental implications. It is no accident that China is now involved in water disputes with most of its neighbors, from Russia and India to even a weak client-state like North Korea, with which it has yet to settle issues relating to Lake Chonji and two border rivers, the Yalu and the Tumen. From Chinese territory, the Amur and the Irtysh rivers flow to Russia, the Black Irtysh and Illy to Kazakhstan, and the Herlen, the Wursun, and the Kara Ertix to Mongolia.

China is also the source of cross-border flows to multiple other countries, stretching contiguously from Kyrgyzstan to Vietnam. For example, China's damming of the border river Shweli and its plans to construct 13 new dams on the Salween River have roiled its relationship with Myanmar. That country sees the upstream projects as a threat to the integrity of its own smaller hydropower projects, some of them actually funded by the Chinese Export-Import Bank and subcontracted to Chinese state-run firms such as China Southern Power Grid and Yunnan Joint Power Development Company. China's focus on dam and other water megaprojects in the homelands of its ethnic minorities has also triggered internal tensions over displacement and submergence at a time when the Tibetan Plateau, Xinjiang, and Inner Mongolia have all been wracked by unrest against Chinese rule.

China is already the largest producer of hydropower globally, with a generating capacity of more than 170 GW at home. It has sought to justify its plans for building many more large dams in the name of meeting renewable-energy targets to address global concerns over its emergence since 2010 as the world's largest emitter of greenhouse gases. In

Uzbekistan has held out military threats against Tajikistan's plans to resume work on unfinished Soviet-era dam projects.

Water has emerged as a key security issue in China-India relations and a potential source of enduring discord.

October 2011, it unveiled a mammoth $635-billion fresh investment in water infrastructure over the next decade, more than a third of which is to be channeled for building dams, reservoirs, and other supply structures.

Whereas riparian neighbors in southern and southeastern Asia are bound by water pacts that they have negotiated between themselves, China does not have a single water treaty with any co-riparian country. It rejects the very concept of water sharing. In this light, it is hardly a surprise that water has become a new divide in China's relations with riparian neighbors. By erecting dams, barrages, and other water-diversion structures in its borderlands, China is setting up an extensive upstream hydro-engineering infrastructure, thereby spurring growing unease and concern in downriver countries.

To be sure, China has a number of bilateral water agreements. But none is about water sharing. While refusing to share water, China is willing to share statistics on the flows of transnational rivers. In fact, it deflects attention from its unwillingness to enter into water sharing or even institutionalized cooperation to sustainably manage common rivers by flaunting the accords it has signed on sharing flow statistics with co-riparian states. These agreements, in reality, are commercial accords to sell hydrological data, which some other upstream countries provide free to downriver states.

Water is becoming a key security issue, for example, in Sino-Indian relations and a potential source of enduring discord. Even though India has more arable land than China, the source of most major Indian rivers is Tibet. India is dependent on cross-border inflows for about one-third of its yearly water supplies.[33] Although China is the source of river flows to multiple countries, none gets the amount of water that flows to India from Tibet. China's aggressive damming strategy thus holds the greatest implications for India.

By overlooking the concerns of its smaller co-riparian states in Southeast Asia and ramping up the upstream construction of more dams and reservoirs, China is now confronting new diplomatic challenges in a region where it had worked to project an image of benevolence and brotherhood. The downstream disquiet over Chinese actions has been compounded by recurrent drought and heavy flooding in the basin ever since the upstream dam-building program began.

At a time when the upstream Chinese dams have helped stir popular passions in Vietnam, Laos, Cambodia, and Thailand, the United States has sought to diplomatically cash in on downstream concerns by launching the Lower Mekong Initiative, or LMI. Seeking to promote integrated cooperation among Cambodia, Laos, Thailand, and Vietnam in the areas of environment, education, health, and infrastructure, LMI emphasizes sustainable hydropower development and natural-resource management, including improving institutional capacity to address connected transnational issues. LMI, however, cannot obscure the imperative to build institutionalized, cooperative arrangements involving all the Mekong Basin states, including China.

Certainly, China, despite its riparian dominance in Asia, faces important water challenges internally. China's average renewable water resources are 2,112 cubic meters (m3) per capita annually, but in its water-stressed north, the figure is just 700 m3 per year.[34] China's intrastate disparity in water availability, which has promoted the steady depletion of underground water resources in the

[33] Aquastat data, 2011.

[34] Food and Agriculture Organization, *Country Fact-Sheet: China*, Aquastat database, 2012.

north, is compounded by the serious problem of water pollution in its industrial heartland.

India, unlike China, has multiple riparian identifiers: It is the upper riparian on some rivers that originate on its territory, such as the Chenab and the Jhelum, which flow to Pakistan, and the Teesta that flows to Bangladesh; it is the mid-riparian on the Brahmaputra, for example; and it is the lower riparian on the rivers that begin in Tibet and flow down via Nepal to drain into the Ganges Basin. Few other states in Asia fall in all the three categories — upper, middle, and lower riparian. Indeed, such is India's geographical spread that it has a direct stake in all the important river basins in South Asia.

India confronts a deepening water crisis, which is more acute than in China. The 2030 Water Resources Group — a consortium of private social-sector organizations formed in 2008 to provide insights into worldwide water issues — has a dire warning for India: The country is likely to face a 50 percent deficit between water demand and supply by 2030.[35] Given the growing inter-country water competition in Asia, water disputes are almost as rife between India and its neighbors as they are between China and its neighbors.

But there are two key differences. One, India has water pacts with all its riparian neighbors other than China, including comprehensive water-sharing treaties with both the countries located downstream to it — Bangladesh and Pakistan. And two, these water treaties contain dispute-settlement mechanisms. The mechanisms help moderate differences or disputes and ensure that they do not escalate to conflict.

In 1960, India signed a treaty indefinitely setting aside over 80 percent of the waters of the six-river Indus system for downriver Pakistan — a level of water munificence not seen in any other pact thus far in modern world history. The Indus Water Treaty indeed stands out as the world's most-generous water treaty in terms of both the total volume of waters and the sharing ratio reserved for a downstream state. Furthermore, this pact, according to a 2011 majority staff report prepared for the U.S. Senate Foreign Relations Committee, is "considered the world's most-successful water treaty, having remained relatively intact for 50 years and having withstood four Indo-Pakistani wars."[36]

India has water treaties with all its riparian neighbors other than China, which rejects the concept of water sharing.

Yet the treaty has not been able to stop bilateral water disputes from surfacing. The treaty, however, contains elaborate provisions to resolve differences or disputes through the appointment of a neutral international expert or a court of arbitration. Water shortages have become acute in Pakistan, which maintains one of Asia's highest population-growth rates. India's own portion of the Indus basin is reeling under growing water stress, with the deficit between water supply and demand estimated at 52 percent.[37] Both countries face difficult choices on water.

India's 1996 Ganges water-sharing treaty with Bangladesh, which ended protracted acrimony over the diversion of water by India's Farakka Barrage, guarantees the downstream state specific minimum cross-border flows in the critical dry season — a

[35] 2030 Water Resources Group (Barilla Group, Coca-Cola Company, International Finance Corporation, McKinsey & Company, Nestlé S.A., New Holland Agriculture, SABMiller PLC, Standard Chartered Bank, and Syngenta AG), *Charting Our Water Future* (New York: 2030 Water Resources Group, 2009), p. 10.

[36] United States Senate, *Avoiding Water Wars: Water Scarcity and Central Asia's Growing Importance for Stability in Afghanistan and Pakistan*, A Majority Staff Report, Prepared for the Use of the Committee on Foreign Relations (Washington, DC: U.S. Government Printing Office, February 22, 2011), p. 7.

[37] 2030 Water Resources Group, *Charting Our Water Future*, p. 56.

Even run-of-river dams have become a source of inter-riparian tensions, although they generally do not alter cross-border flows.

new principle in international water relations. This provision means that even if the river's flows were to diminish due to reasons beyond India's control — such as climate change or the Chinese damming of a key Ganges tributary, the Arun (also known as the Kosi), which contributes significantly to downstream Ganges water levels — India would still be obligated to supply Bangladesh at least 35,000 cubic feet of water per second of time (cusecs) in the dry season, as stipulated in the treaty.

The Ganges treaty has been smoothly implemented, but new disagreements have flared in other river basins shared by Bangladesh and India, especially over India's revival of a long-dormant multipurpose project, Tipaimukh, in its remote Manipur State, bordering Myanmar. Located 210 kilometers upstream from the Bangladesh border on the Barak River and designed to control floods, improve river navigation, and generate 1,500 MW of hydropower, the Tipaimukh Dam had been held up for years by grassroots concerns on the Indian side over displacement and submergence. To help resolve bilateral differences over the planned revival of this project, India has arranged tours by Bangladeshi officials and lawmakers to the project site.

Separately, Bangladesh wants India to reserve for it about half of the waters of the Teesta River, which originates in the Himalayan Indian state of Sikkim and has a much smaller cross-border discharge than the Brahmaputra and the Ganges. The draft text of the proposed Teesta treaty has been under discussion since at least 2010, and the two countries are expected to reach final agreement before long. When signed, this agreement is likely to become the world's first water-sharing treaty of the 21st century.

India, however, is downriver to China, which is willing to neither enter into water-sharing arrangements nor grant onsite access to its dam projects. Nepal and Bhutan, which sit on vast Himalayan hydropower reserves, are also located upstream to India. Nepal, which is in danger of becoming a failed state, holds up to 83,000 MW of potential hydropower reserves, yet it produces less than 800 MW of electricity for its 30 million citizens from all sources of energy and actually imports power from India.

Several water treaties underpin the India-Nepal relationship. Yet the two countries have made slow progress in expanding bilateral water cooperation. The Bhutan-India water relationship, by contrast, has flourished through joint, small-scale hydropower projects, with electricity exports swelling Bhutanese coffers.

Modest-Sized Dams also Generate Political Tensions

In Asia, such is the competition over water resources that even run-of-river projects have become a source of inter-riparian tensions, although, unlike multipurpose storage dams, they generally do not alter cross-border flows. Such dams are mostly small in scale and employ a river's natural flow and elevation drop to produce electricity, without the aid of a large reservoir or dam. Even their environmental impact is often minimal.

However, because such dams heavily rely on a river's natural flow rate and drop, there is a constraint on the location and size of run-of-river projects. Even if power demand increases, it is often not possible to step up such a project's energy output. More important, the size and flow of streams fluctuate in many locations, with less river flow in the lean season translating into less power output from a run-of-river system.

How run-of-river systems can stoke inter-riparian tensions is best illustrated by Pakistan's impassioned objections to such upstream Indian projects — to the extent that Pakistan took one such project

to a World Bank-appointed neutral expert for settlement and another to the International Court of Arbitration, where the matter is still pending.

Under the Indus Waters Treaty, India is allowed to build run-of-river systems on the three large rivers reserved for Pakistan. The treaty indeed enforces a set of elaborate restrictions on India in order to ensure that such dams will not materially change transboundary flows. For example, the initial filling of any dam is restricted by the treaty to the mid-monsoon period, when rivers are in spate. The treaty's severe limits on "pondage" (or the limited amount of water held back in a small dam to generate steady hydropower) also ensure that India has no control on the timing or quantum of transboundary flows.

Pakistan's spat with India over the Baglihar hydropower project ended up raising that project's costs, even though the World Bank-appointed neutral expert ultimately ruled largely in India's favor in February 2007.[38] The neutral expert — a Swiss national — demolished most Pakistani claims on the 450 MW project, which had been presented to the Pakistani public as asymmetrically arming India with the capability to unleash transboundary flooding, even though the dam is located nearly 120 kilometers upstream from the Pakistani border and any such Indian action would wreak havoc largely on the Indian side. The neutral expert's final report gave the go-ahead to India to complete the project with marginal design changes.

In 2010, Pakistan filed a case with the International Court of Arbitration to halt India's construction of the small, 330 MW Kishenganga plant, which is also based on run-of-river technology. Pending the conclusion of the arbitration proceedings, India has ceased work on the plant, which had been on the drawing board for decades before it was taken up for implementation in recent years.

Like Baglihar, the Kishenganga project is in the Indian portion of the divided state of Jammu and Kashmir. The otherwise resource-poor Indian portion of Jammu and Kashmir has only one natural resource, water. But under the Indus Waters Treaty, its three main rivers were reserved for downstream Pakistan, with the upstream uses in India severely limited. This has bred burgeoning local resentment, which led the Jammu and Kashmir State legislature to pass a bipartisan resolution in 2002 calling for a review and annulment of the treaty. To help allay popular resentment in the state over the major power shortages that are hampering its development, India subsequently embarked on projects like Baglihar and Kishenganga.

Even as these projects have drawn Pakistan's ire, Pakistan has embarked on building multiple new dams in the part of Kashmir it holds. The projects, several of them being built by Chinese companies, include the 969 MW Neelum-Jhelum Dam, the 1,100 MW Kohala-Jhelum Dam, and the massive 4,500 MW Bhasha Dam (also known as Diamer-Bhasha), which will have an 80-kilometer-long reservoir in the Himalayan foothills. Yet another giant project is a 7,000 MW dam at Bunji, which, like Bhasha, is to come up in Kashmir's northernmost Gilgit-Baltistan region, troubled by a long-simmering Shiite rebellion.

Pakistan has taken its dispute over a modest-sized Indian dam project to international arbitrators.

[38] The Indus Waters Treaty: The Baglihar Hydroelectric Plant, "Expert Determination on Points of Difference Referred by the Government of Pakistan under the Provisions of the Indus Waters Treaty," full text of the neutral expert's report, http://goo.gl/okjxh.

5 Containing the Geopolitical Risks

Transparency and information sharing are critical to preventing water conflict and addressing informational deficits and mistrust.

Asia is the hub of global water challenges. The numerous new dam projects in Central, South, Southeast, and East Asia show that policymakers still seek to engineer potential solutions to the water crisis via traditional supply-side approaches, when the imperative now is to improve water-use productivity and efficiency and to tap non-traditional sources, ranging from wastewater reclamation to rainwater capture.

How can Asian governments prevent the "dam racing" from becoming a tipping point for overt conflict? As history attests, the relative scarcity of natural resources, including water, can contribute to political conflict. In Asia, intrastate water disputes, including over dam building, have become even more common than inter-country wrangles. Yet the inter-country water discord carries greater strategic implications. Such discord, even if it does not escalate to overt conflict, can impede the establishment of broader regional cooperation and integration. It is thus vital to defuse such discord.

Inter-country dependence on waters from shared rivers or aquifers is widespread across Asia. In the interstate context, Azerbaijan, Bangladesh, Cambodia, India, Kazakhstan, Laos, Pakistan, Thailand, Turkmenistan, Uzbekistan, and Vietnam receive between 31 percent and 97 percent of all their water supplies from across their national borders.[39] In contrast, China is happily placed because its dependency on external water inflows is less than 1 percent — one of the lowest in the world. China — unlike impoverished states like Bangladesh and Afghanistan — also has the financial resources to engineer potential mitigation of its internal water challenges.

Broadly speaking, long-standing inter-country tensions and internal instabilities, coupled with soaring water demand in an era of environmental degradation, have made a number of the transnational basins in Asia potential flashpoints for serious water conflicts. A U.S. intelligence assessment publicly released in March 2012 has warned that "the use of water as a weapon will become more common during the next 10 years with more powerful upstream nations impeding or cutting off downstream flow."[40] The report — prepared at the request of the State Department, and based on a classified National Intelligence Estimate — identified several transboundary basins in Asia, including the Brahmaputra, Mekong, Indus, and Amu Darya, as zones of concern. Heavy dependency on river waters controlled by an upper riparian with which the downriver nation has festering water-sharing issues can contribute to greater downstream water stress, especially when the upstream controller's dam projects siphon off water supply.

Building institutionalized cooperation between riparian neighbors is thus critical to stemming the dam-building competition and containing the associated geopolitical risks. Transparency and information sharing must be integral to such cooperation so as to address informational deficits and mistrust. After all, the Asian public discourse on transboundary water resources tends to very political because it is guided more by national considerations than by cross-basin interests. Worse still, data on water resources and river flows is closely guarded.

Multilateral initiatives to collect and publicly disseminate reliable data on river flows and other important aspects of water resources can greatly contribute to transparency and contain both the distortion of basic facts and the whipping up of

[39] FAOSTAT, 2012.

[40] U.S. National Intelligence, *Global Water Security*, Intelligence Community Assessment ICA 2012-08, February 2, 2012 (Washington, DC: Office of the Director of National Intelligence, March 22, 2012), p. 4.

water nationalism. Dependable data, in any event, is crucial to promote efficient resource allocation and utilization and to build inter-country cooperation. Reliable data indeed can serve as the building blocks for basin-level collaboration.

It is also important for Asian states to develop common norms on dam building so that such projects are pursued transparently and without materially affecting cross-border river flows. The norms must be designed to help rein in the current "dam racing," which is pivoted on the *doctrine of prior appropriation* that legitimizes the principle, "First in time, first in right." Under this doctrine of customary international water law, the first user of river waters (whether an upstream or downstream state) acquires a priority right to the utilization of river waters, as long as those resources are diverted for "beneficial" applications, including irrigation, industrial or mining purposes, electric-power generation, and municipal supply. The U.S. Supreme Court, in the case *Wyoming v. Colorado*, lent full support to this doctrine as a way of establishing the right to use scarce waters from rivers and streams.

China, by taking the lead to appropriate the resources of shared rivers, has sought to set itself as the prime user of the waters of international watercourses — a country whose water rights are protected under the doctrine of prior appropriation vis-à-vis downstream countries, including Myanmar, India, Kazakhstan, and Russia. India's own moves in recent years to initiate dam projects in the state of Arunachal Pradesh, along its northeastern border with Tibet, have been driven by its apparent intent to assert a priority right as the first user of river waters, even though India is located downstream. Yet grassroots protests and red tape have delayed its projects.

The doctrine of prior appropriation has also influenced Pakistan's moves. Pakistan took India's Kishenganga Dam project to the International Court of Arbitration under the Indus treaty's dispute-settlement provisions, and succeeded in getting the arbiters to order India last year to suspend construction. Meanwhile, Pakistan has put the construction of its own three-times-larger hydropower plant on the same Himalayan stream on the fast track to gain a priority right on river-water use under the doctrine of prior appropriation. This Chinese-aided, $2.16-billion Pakistani project — formally known as the Neelum-Jhelum Hydropower Plant — is located nearby at a border site, downstream from the Indian project.

By encouraging a dam-building competition, the doctrine of prior appropriation has proved problematic.

In the inter-country context, the doctrine of prior appropriation is problematic because it encourages the trend being witnessed in Asia — a dam-building competition. The only way to alleviate the "dam racing" is by building treaty-based water institutions. Such institutions cannot completely eliminate a dam-building competition, as the experience in the Mekong and Indus basins illustrates, but they can help contain rival plans through institutional mechanisms, including dispute settlement.

It is thus critical to get China to drop its opposition to entering into water-sharing institutional arrangements. As the geographical hub of Asia and the source of transboundary water flows to the largest number of countries in the world, China looms large on the Asian water map. Just as Saudi Arabia sits over vast reserves of oil, China's control of vast water resources gives it significant clout over its co-riparian states. Water in the 21st century could easily become what oil was to the 20th century — a source of both wealth and conflict. In fact, the rise and fall of powers in Asia could be influenced by water in much the same way that oil in the last century played a key role in determining the ascent or decline of states.

China can play a leadership role if it were to accept water-sharing arrangements and cooperative mechanisms.

Figure 11: Dams on the Mekong, Including Those Planned

Source: Mekong River Commission.

China can actually play a leadership role in building Asian water collaboration if it were to accept water-sharing arrangements and cooperative mechanisms. Take the Mekong Basin. The only institution that can promote wise, sustainable management of water resources there is the Mekong River Commission, which was set up by Laos, Cambodia, Thailand, and Vietnam through a 1995 treaty backed by multinational aid donors. This intergovernmental commission can serve as an effective mechanism for cooperative water-resource management only if China joins as a member.

China, however, is a dialogue partner but not a member of the commission. This reflects its intent to listen to the discussions among other basin states without agreeing to abide by the commission's rules or taking on legal obligations by becoming a party to the Mekong Treaty. But where its commercial interests can be advanced, China has zealously pushed for integration in the Mekong region in the areas of trade, investment, communication, transportation, and energy. For example, the world's largest free-trade area by population, covering the 1.9 billion people in China and the ten-nation Association of Southeast Asian Nations (ASEAN), took effect in 2010. China has also advanced its river-navigation interests by signing contracts and blasting rapids, shoals, and reefs in the lower Mekong so as to allow ships of greater tonnage to ply the river.

To protect its commercial interests, it has even started deploying armed Chinese police vessels on the piracy-plagued waters of the Mekong in northern Laos and Myanmar.[41] Yet on the resources of common rivers, China shies away from agreeing to water-sharing arrangements or entering into regional collaboration on the sustainable management of shared waters.

So, getting China on board holds the key to promoting peaceful and mutually beneficial cooperation on shared water resources in Asia. Without such success, transboundary water governance is likely to become an increasingly pressing challenge, with China's new hydro-engineering projects on international rivers arming it with greater leverage over its riparian neighbors, including the ability to manipulate cross-border flows.

[41] Xinhua, "Four-Nation Patrol Succeeds in First Escort Mission Over Mekong," December 13, 2011.

As the challenges in the Great Himalayan Watershed highlight, the environmental future of much of Asia is tied together. This reality underscores the imperative to build multilateral cooperation to help protect the ecological well-being of the Himalayan and Tibetan highlands. After all, shielding the ecological health of these highlands is integral to the water-related interests of Asian societies, including the stability of the monsoonal cycle and weather patterns.

The major dam projects undertaken or planned by various countries on these highlands will ultimately affect everyone downstream. If water as a resource is to build cooperation and not instigate conflict, the protection of shared basin resources must become a key part of bilateral and multilateral initiatives. The emerging hydrological threats should be seen as opportunities for inter-country and basin-wide collaboration.

China and India have taken a small step toward mutual cooperation by reaching agreement on a joint academic study on the thawing of the Himalayan glaciers.[42] Bhutan in November 2011 hosted a summit meeting of Himalayan countries in an effort to draft a collective ten-year blueprint to address the multiple threats from climate change. The meeting was attended by India, Bangladesh, and Nepal, along with aid agencies, donors, NGOs, and environmentalists, but not by China, Pakistan, and Myanmar. State policies must be mindful of the wider environmental impact of national water projects, including the potential transboundary effects.

More broadly, harmonious ties between countries sharing any watercourse depend on each riparian state exercising its water rights in such a way as not to affect the ecosystems or the rights of a co-riparian. To moderate competition and build rules-based cooperation, institutional mechanisms are indispensable. The imperative for building institutions at the bilateral or basin-wide level is underlined by the fact that there is no international water treaty presently in effect.

The 1997 United Nations Convention on the Non-Navigational Uses of International Watercourses, although designed to serve as the foundation for governance of international transboundary water resources, has still not entered into force. Thus far, only 24 contracting states have ratified the UN convention — 11 short of the number required for the convention to take force. And even if the convention takes effect, it will bind only those states that have signed and ratified it. Today, the harsh reality is that there are no practical enforcement mechanisms internationally available to prevent any country from materially altering cross-border flows of a transnational watercourse through dam building.

That is why it is important for co-riparian states in Asia to build cooperation on the basis of jointly agreed rules, using as a guide the codification of the principles of customary water law by the UN convention. Inter-country water institutions, if founded on international norms of fair utilization and doing no harm to co-riparian states, would help to stem the risk of disputes flaring into overt confrontation or armed conflict, including by facilitating constructive dialogue and structured cooperation. To be effective, they must provide for dispute-settlement mechanisms, including independent fact-finding and international arbitration, or adjudication by the International Court of Justice. It is troubling that most of the 57 internationally shared river basins in Asia lack legally binding arrangements for water sharing or basin-wide cooperation.

Because there is no international water treaty presently in effect, it is crucial to develop water institutions at the bilateral or basin-wide level.

[42] Xinhua, "China, India to Jointly Research Himalayan Glaciers," March 25, 2010.

Although establishing institutionalized cooperation in any international basin is often a challenging task, such collaboration is necessary to build a mutual stake in maintaining the sustainability of basin resources. It is also essential to underpin strategic stability, protect continued economic growth, and promote environmental protection.

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