Troubled Waters

Climate Change, Hydropolitics, and Transboundary Resources

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South Asian Perspectives on Climate Change and Water Policy

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South Asia—Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka—covers 3.3 percent of Earth's terrestrial area, but supports more than one-fifth of the world's inhabitants. According to UN statistics, the region's population will rise by another 800 million people by 2050.[1] Historically, the South Asian region has been perceived as having plentiful water resources, including the magnificent Himalayan snows, a vast network of perennial rivers, high monsoon rainfall, and rich groundwater aquifers. However, with the rapid population growth during the last century, pressure on these water resources has reached alarming proportions. Water availability per capita has decreased by almost 70 percent since 1950, and it is projected that by 2025, most of the region will be facing either physical or economic scarcity of water (when human, institutional, and financial capital limit access to water resources even though they are naturally available).[2] Significantly, the countries of South Asia share common water resources and common water usage patterns, and so also share common water management challenges. First among them is a widely accepted notion that South Asia is one of the least integrated regions in the world.

In addition to population pressures, intensifying agriculture and expanding industrialization have contributed to an inexorably increasing demand for fresh water. What is more, steadily growing incomes and rapid urbanization have brought a dramatic change in lifestyles that affect the amount and distribution of water demand. There are inherent limitations in strategies to address these problems, but efforts include augmenting supply by developing greater storage in dams and reservoirs, facilitating interbasin transfers, and creating underground storage and transfer structures. These have yielded some positive results and also have potential for further extension. Although water is usually considered a renewable resource (with the exception of underground fossil water), it is actually a finite one with physical limits on its sustainability. The capital stock of water is gradually being eroded. With several river basins becoming parched and the uncontrolled extraction (even "mining" in some locations) of groundwater, supply in absolute terms is decreasing in many parts of South Asia.

Apart from the physical scarcity of water, the imbalance between demand and supply has put a severe strain on management and institutional systems. The irrigation sector, which is the region's primary water user, is facing a serious crisis of low efficiency levels, technological obsolescence, and financial nonviability. The public utilities responsible for domestic water supply are unable to deliver satisfactory service because water tariffs and returns on investment are too low even to enable adequate maintenance, let alone overdue improvements. In the absence of effective regulatory mechanisms, the increased utilization of water by industry is causing problems of waste, pollution, and deteriorating water quality. Consequently, physical scarcity of water is compounded by economic scarcity. The system can neither meet current needs nor generate the resources for creating future infrastructure. This is an unsustainable situation.

To add to this basket of woes, climate change introduces a whole new dimension to the water challenge. The impact of climate change on rainfall patterns, river flows dependent upon glacial melt, and sea levels has only recently begun to be scientifically assessed with any degree of accuracy. Nevertheless, a recent report of the Intergovernmental Panel on Climate Change (IPCC) concludes that it is "very likely (a greater than 90 percent probability) that…most river basins are likely to become drier leading to persistent water shortages."[3] Moreover, glacial melt that today supplies 80 percent of the dry season flow to the major northern rivers could see this contribution reduced to 30 percent over the next 50 years.

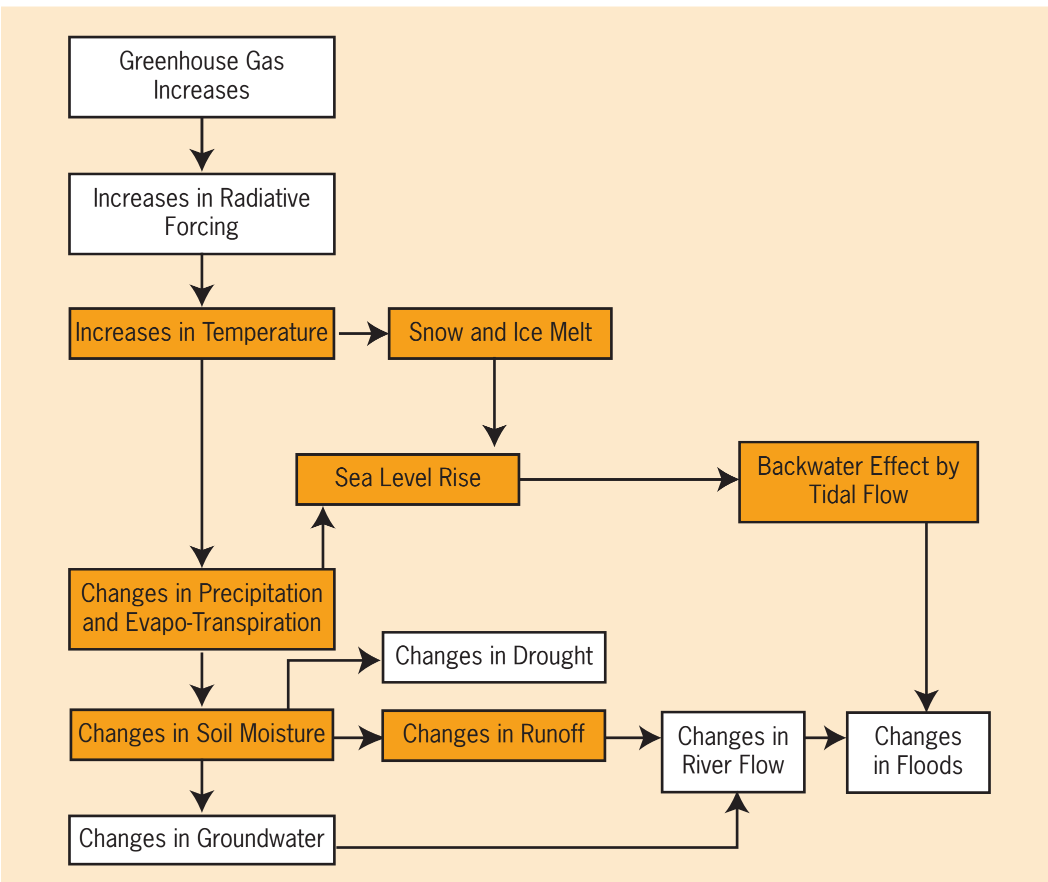
There has been some official recognition of the impending crisis. In recent years, the governments of all countries in the region have brought water issues into the forefront of their national agendas with greater emphasis. Bangladesh, Bhutan, and India have formulated national water policies. However, the institutional structure for policy formulation and program implementation is highly fragmented, with a number of central and state ministries mandated to address climate- and water-related issues. The resultant turf battles detract from the pursuit of comprehensive and cohesive agendas.

At the regional level, there has also been a welcome recognition of the threats posed by global warming and the associated vulnerability and adaptation capabilities of different economic sectors. The joint declaration adopted by the South Asian Association for Regional Cooperation (SAARC) environment ministers in July 2008 expressed the concern that "SAARC is the most vulnerable region to climate change that is seriously affecting our agricultural production, crippling our vital infrastructures, diminishing our natural resources, and limiting our development options for the future."[4]

What the joint declaration did not touch upon, perhaps for reasons of diplomatic nicety, is that the threat to water security has the potential to spill over and accentuate regional political tensions. Water has long been a contentious issue among the nations of South Asia, which share major transnational river basins. A report by International Alert that identifies 46 countries where climate change and water-related crises create a high risk of violent conflict includes Bangladesh, India, and Pakistan.[5] Water has also been a source of intranational dissension, such as a dispute between the Sindh and Punjab provinces over the Indus River, and one between the Indian states of Karnataka and Tamil Nadu over the Cauvery River. Clearly, increased water scarcity as a result of climate change has implications not only for the region's socioeconomic development and the war against poverty, but also for its overall peace and political stability.

As detailed in figure 1, the relationship between climate change and the hydrological system is extremely complex. This paper seeks to examine these linkages in the context of South Asia and to draw out the consequent implications for water policy in its multiple dimensions. The fact that significant uncertainty makes it difficult to precisely estimate the impacts of climate

Figure 1: Climate Change and Water Resources in South Asia



Source: M. Monirul Qader Mirza and Q. K. Ahmad, eds., Climate Change and Water Resources in South Asia (London: Taylor & Francis Group, 2005).

change cannot be an excuse for inaction. The broad emerging trends provide enough guidance for addressing potential outcomes. Clearly, there is an urgent need to do so.

Climate Change and Water Resources

South Asia is a region of diverse climates. From the arctic temperatures of the Himalayas covering the northern parts of Afghanistan, Bhutan, India, Nepal, and Pakistan through the arid areas of southeastern Pakistan and western India to the intense tropical humidity of Bangladesh, southern India, the Maldives, and Sri Lanka, these varying climatic conditions bear directly on production patterns, livelihoods, and socioeconomic structures. Climate is a major determinant of water availability in South Asia. The primary sources of water are the snow melt from the Himalaya and Hindu Kush mountain ranges and the cyclical monsoons. The Himalayas are described as the "water tower" for South Asia. Whereas the three largest river systems of the Indus, Ganges, and Brahmaputra are partially fed by snow and glaciers, the Southwest Monsoon accounts for 70 to 90 percent of the annual rainfall over most of the region. For Sri Lanka and the Maldives, the Northeast Monsoon is the dominant factor. There is considerable spatial and temporal variation of monsoon activity within the region, and, consequently, sharp contrasts in water availability and consumption. For instance, annual precipitation in northeast India and north Bangladesh can reach up to 5,000 millimeters,[6] while most parts of Afghanistan and the desert areas of Pakistan and India receive very scanty rainfall.

Global climate change due to the enhanced greenhouse effect has emerged as one of the most challenging environmental issues for the 21st century. Emissions resulting from human activities are contributing substantially to an increasing warming of the Earth's surface. According to the Fourth Assessment Report of the IPCC, global mean surface temperature has increased by some 0.6°C over the last 100 years and will continue to rise during the current century, with regional variations. As a result, the hydrological cycle will be affected, producing an expected rise in the global mean sea level of 0.18 to 0.59 meters by 2100, and an increase in the frequency and intensity of precipitation.[7] Indeed, a number of studies indicate that there has been an increase in the interannual and intraseasonal variability of rainfall because of general warming, and that relatively small climatic changes can lead to droughts and floods on a fairly wide scale.

Extreme climatic events, such as floods, droughts, and cyclones, that recur periodically already often result in large-scale destruction of infrastructure, property, and human lives. In addition, rising sea levels are increasingly exacerbating saltwater intrusion into coastal freshwater systems. In the Indian districts of Tamil Nadu and Gujarat, increasing groundwater salinity caused by seawater penetration into the subsurface aquifer has become a major cause for concern. And in the eastern coastal areas of West Bengal and Orissa, the appearance of arsenic in fresh water as increased groundwater usage draws down the water table is endangering human lives. Future changes in climate are likely to exacerbate these problems and affect millions of people, especially the poorest, most vulnerable, and marginalized populations.

South Asia's water supplies are especially vulnerable to shifts in glacial melting. The Himalayan glaciers extending over 17 percent of the mountain area form the life-supporting repositories of water feeding the major river systems of the Indus, Ganges, and Brahmaputra. There is a serious dearth of accurate data about these glaciers. A better understanding of glacier dynamics and hydrology is vital for future water policy and management. Still, on the basis of available evidence, scientists agree that the Himalayan glaciers are receding at a faster rate than those in other parts of the world.[8] In the short run, melting glaciers would supply more water to the dependent perennial rivers in India and Pakistan. The same process, however, would also bring more sedimentation into dams and reservoirs, thereby reducing their economic life. Accelerated glacial retreat would also increase the risks of glacier lake outburst floods in Bhutan and Nepal, as melting ice would open breaches in the ice walls that water in glacial lakes. In the longer term, upstream flows would greatly diminish as the glaciers declined, posing serious problems to water supplies for drinking, agriculture, and other livelihoods, as well as reducing hydropower potential.

Groundwater is another important source of supply in many parts of South Asia, and is being increasingly exploited by farmers because of its easy accessibility, amenability to greater control, and better quality than polluted surface water. In contrast to an earlier reliance on state-managed canal irrigation, private tube wells have come to play an increasing role in supporting agriculture. With improvements in technology, rural and urban drinking water supplies have also become increasingly dependent on groundwater extraction. Similarly, more and more industries are opting to use private tube wells for their water requirements rather than depend upon unreliable state sources. In Bangladesh, groundwater makes up 75 percent of total water use in irrigation,[9] and a majority of the country's population gets its domestic supply from hand pumps. In India, about 1 million large and small mechanized wells are built every year.[10] The reliance on groundwater might compensate for inefficiently run public infrastructure, but misguided populist policies (e.g., generous electricity and diesel subsidies encouraging mechanized wells) and weak regulatory mechanisms, including permissive laws, have led to gross overexploitation and resource degradation. As climate change increasingly threatens freshwater supplies, increasing demand will likely fall on the remaining stores of groundwater.

Water Demand and Supply

The South Asian region has experienced a steady decline in physical water availability due to changing demographics, expanding economic activity, rapid urbanization, and changing consumption patterns. Other factors such as technology (cropping patterns and irrigation systems), institutional structures, and pricing policies also play a significant role in determining water demand and usage. The Falkenmark water stress indicator provides one metric for gauging the adequacy of water supplies; this indicator considers 1,700 cubic meters per person per year to be the national threshold for meeting water requirements for agriculture, industry, and domestic use. Availability below 1,000 cubic meters represents a state of "water scarcity," and below 500 cubic meters reflects "absolute scarcity." Per capita water availability in South Asia has fallen from about 21,000 cubic meters per annum in 1960 to about 8,000 cubic meters in 2005. Should this trend persist, the region will be faced with widespread water scarcity by 2025.[11]

In most countries in South Asia, agriculture continues to be the most important sector of the economy in terms of its contribution to GDP, food security, and employment. It is also the largest consumer by far of freshwater resources (see table 1). Despite the high growth rates in the industrial and service sectors, this demand structure is largely expected to persist for the foreseeable future. Projected water allocations suggest that by the year 2025, agriculture will continue to be the primary user of fresh water, even as domestic and industrial demands, including energy, increase sharply. Given the overall scarcity condition, even small changes in sectoral allocations can generate social tensions, and this has to be taken into consideration when formulating policy. There are already several instances of farmers objecting to new industrial units being built in water-stressed areas, and communities protesting over water pollution being caused by industrial effluent.

The widely acclaimed successes of the "green revolution" across South Asia, initially led by Pakistan and India, were primarily driven by the expansion of irrigation infrastructure. Whereas the dramatic increase in cereal production was instrumental in moving toward

Table 1: Countrywide Freshwater Withdrawal by Sector, 2000 (Percentages)

Country	Agricultural	Domestic	Industrial
Afghanistan	98.19	1.81	0.00
Bangladesh	96.17	3.19	0.65
Bhutan	95.24	4.76	1.19
India	86.46	8.09	5.45
Nepal	96.46	2.95	0.59
Pakistan	96.03	1.93	2.05
Sri Lanka	95.24	2.38	2.46
Average	94.83	3.59	1.77

Source: FAO, AQUASTAT database.

attaining food self-sufficiency, the accompanying technological innovations, such as fertilizer and insecticide application, were both capital and water intensive. As a result, irrigation intensity (the degree of multiple cropping in an area of irrigation) has increased considerably across the region. While global irrigation intensity is 117 percent, in the two largest South Asian economies of India and Pakistan, it is 132 percent and 123 percent, respectively.[12] There has also been a significant change in the pattern of irrigation. During the early stages of agricultural transformation in the region, surface irrigation through dams, reservoirs, and canals accounted for most of the irrigated area. With time, the efficiency levels of the highly subsidized, state-managed system dropped and farmers turned to exploitation of groundwater, which was more directly under their own control and provided access to timely availability. Now, in Bangladesh, India, and Pakistan, groundwater irrigation accounts for the larger part of additional irrigated area. In Bangladesh, which had hardly any groundwater irrigation until 1960, the area irrigated by wells expanded from 4 percent in 1972 to 70 percent in 1999 (see table 2). While there is no denying that groundwater has been a major contributor to the increase in agricultural productivity and food security, overextraction, and indeed "mining" (tapping deeper aquifers) in many water zones is taking a heavy toll on both the quantity and quality of fresh water. In several places in Pakistan and India, groundwater levels are falling by 1 to 3 meters per year. The motivation to rely more upon groundwater has been fueled by populist policies that provide heavy subsidies for electricity, fertilizer, and pesticides, backed up with generous support prices for food grains. While the need to regulate and control groundwater extraction is generally acknowledged, the ambiguous legal framework is equivocal concerning water rights and ownership. In the absence of specific laws, ownership of water resources is equated with land ownership, and therefore the power of the state to restrict utilization is circumscribed. Indirect regulatory mechanisms, such as environmental laws, have not thus far been effective in curbing this trend. Given the political clout of the landowning class in these countries, the prospects of implementing fundamental legal reform measures are not

Table 2: Groundwater Irrigation in South Asian Countries

Country	Total hectares under groundwater irrigation	Groundwater-irrigated area as share (%) of			
		Global groundwater-irrigated area	Country's total area	Country's total cultivated area	Country's total irrigated area
India	26,538,000	38.6	8.1	15.6	53.0
Pakistan	4,871,000	7.1	6.1	22.0	30.8
Bangladesh	2,592,000	3.8	18.0	30.8	69.1
Afghanistan	36,0007	0.5	0.6	4.6	11.5

Source: Shah et al. 2000.

very good. Instead, groundwater policy will need to reduce—and preferably gradually eliminate—subsidies that encourage unlimited groundwater exploitation, introduce disincentives through more realistic pricing mechanisms, and promote artificial recharge technologies.

Climate change poses an added threat to groundwater resources in the coastal areas of Bangladesh and India. In Bangladesh's southwest, water and soil salinity have been increasing because of reduced dry season flows that result from excessive upstream withdrawals in India. This process could be expected to intensify as river flows change due to melting glaciers and variations in precipitation. At the same time, rising sea levels lead to saltwater intrusion into coastal aquifers, which affects agriculture and drinking water. More intense storm surges may also inundate low-lying coastal deltas, tainting freshwater stores.

In the agricultural sector, water resources are under stress not only because of overextraction of groundwater, but also because of inefficient practices and the externalities associated with intensive irrigation. Of all sectors, agriculture has the lowest water use efficiency and the lowest output per unit of water. What is more, with higher incomes and consequent changing dietary patterns, there is a growing demand for meat and dairy products, which require even greater water inputs. Given the limited possibilities for bringing more land under cultivation in the countries of South Asia, it cannot be assumed that the increasing demand for food will be met by expanding the area under irrigation. Thus, the importance of better water management cannot be overstated. Despite exhortations from policymakers and the scientific community, the entrenched water bureaucracies have, so far, successfully resisted institutional reforms.

As noted earlier, there are limits to the augmentation of supply, but international financial institutions, such as the World Bank, have been strenuously promoting greater investments in water infrastructure. For example, rich countries such as the United States and Australia (which are also facing water stress problems), have built over 5,000 cubic meters of water storage per capita; middle-income countries, such as South Africa and Mexico, can store about 1,000 cubic meters per capita. But India has only developed a storage capacity of 200 cubic meters per person. With increased variability of rainfall and rapid glacial melting, many experts argue that the need for storage will become even more important.[13] While there is a general consensus about this, there is strong disagreement about how best to create more storage. The World Bank, joined by water bureaucracies in the region, asserts that mega-projects, including large dams and interbasin transfers, are the answer. Environmentalists and social scientists disagree, maintaining that the ecological and social costs of such a strategy are prohibitive and contradict fundamental principles of sustainable development. Instead, these analysts advocate the adoption of an alternative approach that emphasizes integrated water resources management, microwatershed development, rainwater harvesting, and the revival of traditional structures, such as tanks and ponds. This ongoing debate is critical and demands the serious attention of policymakers.

On the other hand, there should be no doubt about the imperative for a major initiative in better demand management. This could be achieved through a combination of measures aimed at reducing water losses in the surface-irrigation system and adopting water conservation technologies and practices. There can be little justification for continuing to accept a situation in which negligible user charges and bloated administrative costs result in 40 to 60 percent efficiency levels, and fail to generate adequate revenues to finance even normal maintenance costs, let alone investment in upgrading the system. However, lack of political will prevents initiatives that would introduce innovative pricing mechanisms and cost-reduction measures. Similarly, while there is a strong case for introducing a package of incentives to promote the use of water-saving technologies, such as drip and sprinkler irrigation, as well as disincentives to discourage inappropriate cropping patterns, faulty policies continue to lead farmers in some water-scarce areas of Pakistan and India to opt for water-intensive crops such as rice and sugarcane. The economic and environmental costs of such exploitative agricultural practices are increasingly being felt. For example, a study conducted by three UN agencies came to the alarming conclusion that the countries of South Asia suffer losses of about US$10 billion annually because of land degradation.[14]

Water and Energy Linkage

The large quantities of water resources in the mountainous parts of South Asia provide abundant raw material for hydropower generation in Bhutan, India, Nepal, and Pakistan. According to UN statistics, developed countries utilize about 70 percent of their hydroelectric potential, whereas the developing world has used only 15 percent. Nepal has an untapped hydroelectric potential estimated at 45,000 megawatts, while that of Bhutan is about 30,000 megawatts. Apart from meeting their own internal demand for energy, hydropower is viewed by these countries as a valuable exportable commodity, with markets in their energy-hungry neighbors, India and Bangladesh. However, variations in water availability resulting from rapid glacial recession, erratic precipitation, and other factors could adversely affect their hydropower potential. There is also concern that existing or future hydro projects based on rivers that have moraine-dammed lakes (naturally dammed with debris deposited by glaciers) at their head could be threatened by more frequent glacial lake outburst floods. Further, higher rates of sedimentation caused by increased river flows and flooding would reduce the economic life of reservoirs and their generation potential.

Droughts and Floods

The countries of South Asia are already vulnerable to periodic droughts and floods. Failure of the monsoon or subnormal rainfalls frequently create drought in Bangladesh, India, Pakistan, and Sri Lanka. Floods and landslides are a regular occurrence in Nepal, which is also particularly exposed to glacier lake outburst floods. The seasonal variation of water flows in the Ganges-Brahmaputra river basins can be extremely wide and unpredictable, causing extensive inundation every year in India and Bangladesh. Climate change, which brings about changes in rainfall patterns, will only exacerbate the situation and introduce even greater uncertainty. According to the IPCC, general warming superimposed on erratic monsoon activity over the semi-arid parts of India and Pakistan would increase their susceptibility to droughts.[15] Heightened monsoon activity over the eastern parts of the Indo-Gangetic Plain would increase the intensity and frequency of floods.

Both droughts and floods have a direct impact on agriculture, the mainstay of millions of people in the region. Since South Asian countries have a limited capacity to cope with disasters because they lack accurate forecasting systems and effective institutional structures, the impacts have historically been all the greater, particularly on the rural poor. For instance, the Bangladesh flood of 1974 resulted in a loss of 1.4 million tons of rice and severe scarcity in the local markets. The consequent price rise meant that large numbers of poor were unable to purchase food grains, resulting in widespread famine deaths. This led to increased migration into neighboring India. The presence of people who have been described as “environmental refugees” has become a source of social and political tension between the two countries. Similarly, in 1993, Nepal experienced its worst natural disaster when torrential rain triggered landslides and major flooding, causing immense loss of property and livestock. The social cost of floods is often compounded by the spread of disease and damage to infrastructure.

Disaster preparedness capacities of the administrative apparatus in all the countries of the region need considerable strengthening and improvement. In recognition of the need for an effective communication network for the timely exchange of weather forecasts and longer term climate data, the SAARC Meteorological Research Centre was set up at Dhaka in 1995. Subsequently, the SAARC Coastal Zone Management Centre in the Maldives and the SAARC Disaster Management Centre in New Delhi were established in 2005 and 2006, respectively. However, the functioning of these institutions is totally dependent on inputs from corresponding national agencies, and turf disputes often create obstacles. Instead of addressing obstacles to effective cooperation head on, the only outcome of the recent July 2008 meeting of SAARC environment ministers in Dhaka was, yet again, to call for an “action plan” for the exchange of information on meteorological data, disaster preparedness, extreme events, and climate change impacts. A concerted multilateral regional agenda for reorienting national policies and institutional structures is yet to be developed.

Water Conflicts

Conventional wisdom suggests that distribution of natural resources in the context of scarcity conditions would in all probability create a conflict situation. In a dramatic articulation of such an eventuality, which many have considered unnecessarily alarmist, Ismail Serageldin, the first chairperson of the Global Water Partnership, declared in 1995, “If the wars of this century were fought over oil, the wars of the next century will be fought over water—unless we change our approach to managing this precious and vital resource."[16] More recently, and in a similar vein, addressing a gathering of business leaders at the World Economic Forum at Davos, Switzerland, in January 2008, UN Secretary General Ban Ki-moon cautioned, "A shortage of water resources could spell increased conflicts in the future. Population growth will make the problem worse. So will climate change. As the global economy grows, so will its thirst. Many more conflicts lie just over the horizon."[17]

Given the vulnerable water scenario in South Asia, the region should be one of the leading contenders for violent conflicts over water sharing—more so in light of its several other political disputes. Mercifully, such has not been the case, so far. On the contrary, while there are outstanding contentious problems among neighboring countries, South Asia does have a commendable track record of making serious efforts toward institutional cooperation over water-related issues in both maritime and riparian areas. Apart from several maritime agreements among member countries, the treaties over the Indus—between India and Pakistan—and the treaties over the Ganges and the Mahakali—between India and Bangladesh and Nepal, respectively—have stood the test of time despite periodic hiccups. However, even these can only be described as interim arrangements to settle differences within a limited context, and by no means establish integrated systems for the optimum development of shared water resources.

The Indus River system is the largest contiguous irrigation system in the world, with a command area of 20 million hectares and an annual irrigation capacity of over 12 million hectares. Although the source of the main Indus River is located in China (Tibet), the headwaters of the basin lie in India, and the bulk of the command area falls in Pakistan. The distribution of the waters is governed by the Indus Waters Treaty, which was brokered by the World Bank and signed by India and Pakistan in 1960. Internationally, the treaty is often cited as an outstanding example of a mutually beneficial agreement that has withstood the vicissitudes of the otherwise strained relations between the two countries, including four wars. Interestingly, however, despite its international acclaim, there is a body of opinion in both countries that the division of waters under the treaty is unfair. The Indian perception is that the state of Jammu and Kashmir has been deprived of storage rights, thus reducing irrigation potential, and that hydropower projects on the western tributaries (Tulbal on the Jhelum and Baghlihar on the Chenab) are stalled because of Pakistan's intransigence. On the other hand, Pakistani dissatisfaction over its share, as a lower riparian user, has found expression in various international forums. In particular, the Pakistani military establishment harbors a persisting mistrust, often voiced, that India could always use its upstream location to disrupt water flows into Pakistan. Indeed, recent media reports indicate a growing demand for renegotiation of the treaty. Another issue that has so far remained intractable between India and Pakistan is the dispute over the Siachen Glacier. Here, armed hostilities have prevented any study of the glacial behavior that is essential for determining water flows into the Nubra Valley in Ladakh and the Skardu region which, further downstream, also merge into the Indus Basin.

The complex interactions between water issues and political relations are similarly reflected in the periodic tensions over the sharing of the 54 big and small rivers that flow from India into Bangladesh. Although a Joint Rivers Commission was established in 1972 as a reconciliation mechanism, and was complemented by the Ganges Water Agreement in 1977, several disagreements persist. Each state holds the other responsible for causing erosion to the river banks. Bangladesh has accused India of reducing water flows in the Ganges, known as the Padma in Bangladesh, through construction of the Farakka Barrage, which was designed to facilitate the flushing of silt from the port of Kolkata. However, the variation in the river flow has perhaps stemmed more from the absence of basin-wide integrated planning and management than from the barrage itself. This is another indicator of the need for more constructive interaction between the two neighbors. Dhaka has also accused India of withholding data regarding river flows for flood control operations, and has vehemently opposed India's plans for the ambitious US$15 billion Inter-Linking Rivers Project, to transfer excess water from the north and east of that country to the water-deficient states of the south and west.[18] For the most part, the water-related tensions between the two states seem to represent the twin dangers of big-country insensitivity and small-country paranoia because, in fact, they are both vulnerable to virtually the same threats from the impacts of climate change and could foster a win-win relationship with greater understanding and cooperation. In the prevailing atmosphere of mutual recrimination, both stand to lose.

Nepal is a relatively small, landlocked country that shares boundaries with India and Bhutan. A large number of rivers and streams flow from Nepal into India. All of them eventually join the Ganga River system and account for a significant part of its flow. The troubled history of water relations between the two countries is yet another example of the intrinsic mistrust small nations can harbor toward a considerably larger neighbor. One effort to overcome this has been the signing of the Mahakali Treaty in 1996 for integrated development of the river, including hydropower generation. In addition to the serious doubts about the treaty surrounding the environmental implications of undertaking large hydroelectric projects in a seismically active Himalayan region, its implementation has fallen into an impasse because of subsequent Nepali misgivings about excessive and unequal dependence on India's energy demand. These have not been satisfactorily resolved.

Thus, while the countries of South Asia have made periodic efforts to cooperate in the sharing and utilization of common water resources, the essential scarcity situation, juxtaposed with extraneous political frictions, has aggravated bilateral differences. The impending impacts of climate change will likely further aggravate the situation. For instance, reduced water flows on account of glacial melt would increasingly compromise the Indus and Ganges river basins, affecting all stakeholders. There are signs of growing anxieties in Pakistan, as the lower riparian, reflected in the demand for revisiting the Indus Waters Treaty to include elements of climate change. Similarly, the all-too-real threat of more serious flooding would involve unimaginable loss of production, livelihoods, and even human life in both India and Bangladesh. The risk that increasing numbers of environmental refugees could migrate from vulnerable areas of Bangladesh into northeastern India would only unsettle an already fragile sectarian balance.

Some more optimistic analysts have espoused an alternative perspective, stressing that these potential environmental challenges should instead be viewed as opportunities for confidence building and conflict resolution among nations. Yet while dialogue and negotiation are certainly the best ways to address disputes, the countries of South Asia must also recognize the essential commonality of water and internalize this in agreements to ensure future sustainability. It would be prudent to guard against a doctrinaire approach to the question of bilateralism versus regionalism. Preparing for the security threats of climate change means not only striving to render these risks less likely, but also developing mutually reinforcing capacities to deal with their effects. The latter cannot be secured by adopting a "fortress" mindset, sealing borders and strengthening defensive capability, but by focusing on the collaborative distribution and management of resources. As Pakistan's former foreign minister, Khurshid Ahmed Kasuri, acknowledged at the SAARC Summit in New Delhi in April 2007, melting glaciers and other common sources of water compel Pakistan, India, and others to cooperate.[19] Such cooperation must go beyond well-meaning rhetoric.

It is incumbent upon the leaders of South Asia to be vigilant to the common threats of climate change and to engage seriously in a new multilateral dialogue to create appropriate regional policies, institutions, and coping mechanisms. This would help allay the apprehensions of relatively small countries such as Bhutan, Nepal, and Sri Lanka, which often find it difficult to negotiate on equal terms with a bigger neighbor such as India. Given the interdependence of natural resource distribution, there are several water-related issues that provide opportunities for regional collaboration. This has not been forthcoming in adequate measure so far. Can the threats posed by climate change provide the catalyst for a new and purposeful initiative in this direction? There are undoubtedly many strong arguments to strengthen the case. South Asia's "water tower," the Himalayas, needs special protection measures. Rapidly receding glaciers and the increased frequency of glacial lake outburst floods pose serious risks to the mountain states of Bhutan and Nepal, and downstream, to India and Bangladesh. The most effective coping strategy would be a mechanism for integrated basin planning and management of the Ganges, Brahmaputra, and Meghna Rivers. The alarming incidence of water logging and salinity in the Indus Basin equally affects Pakistan and India, and the spread of arsenic contamination in groundwater is a major health hazard in Bangladesh and eastern India. The institutional framework of SAARC, which has achieved little so far, needs to be strengthened and made more purposeful so as to promote the exchange of information and experience as well as joint research and collaborative projects. This is the real challenge for diplomacy in the region. Further, intercountry cooperation can be extended beyond governments and academic institutions to corporate bodies and civil society. The Global Water Partnership, South Asian Farmers Forum, South Asian Integrated Water Resources Management Consortium, and the International Centre for Integrated Mountain Development are some of the NGOs making efforts to bring about greater regional cooperation.

Another important strategic issue for the geopolitics of water in the region is China's plan to harness the immense water resources of the Tibetan plateau. Tibet's massive glaciers, deep alpine lakes, and innumerable water bodies feed one of the planet's greatest river systems. Almost half the world's population (Bangladesh, Bhutan, Cambodia, China, India, Laos, Myanmar, Nepal, Pakistan, Thailand, and Vietnam) lives in the watersheds of these eight major rivers (Brahmaputra, Indus, Karnali, Mekong, Salween, Sutlej, Yangtze, and Yellow). Over the last two decades, along with the development of infrastructure, such as paved roads and the Lhasa railway, have come new mining and manufacturing activities, resulting in more air and water pollution. Tibetan protestors drew attention to these environmental threats during the widespread demonstrations in March 2008.

Chinese engineers and hydrologists have trained their sights on harnessing the huge untapped reserves of water and energy from the gorge formed by the Brahmaputra (Tsangpo) just before it enters India in the state of Arunachal Pradesh. The highly ambitious Great South-North Water Transfer Project, designed to transfer waters of the Brahmaputra in the Tibetan highlands to the parched Yellow River, has generated considerable controversy as it involves building deep tunnels and huge dams through high mountains. Apart from the technical difficulties and substantial costs, the environmental impact and their cascading effects on Bangladesh and India are matters of concern. According to the IPCC, the region's warming climate is already causing glaciers to withdraw almost 1 meter per annum, portending substantial impacts on future water flows. While China's water resources minister, speaking at Hong Kong University in 2006, described this ambitious project as not viable, the director of the Yellow River Water Conservancy Committee has stated publicly that the project has official sanction and could be started in 2010.[20] If so, it would call for serious concerted deliberation by South Asian countries which would do well to heed the words of Peter Gleick, president of the Pacific Institute for Studies in Development, Environment, and Security and an eminent water expert: "The water of Tibet may prove to be one of its most important resources in the long run—for China and for much of Southern Asia. Figuring out how to sustainably manage that water will be a key to reducing political conflicts and tensions in the region."[21]

Research Agenda

It is now generally accepted that almost all the countries of South Asia are facing a water crisis even while variations in national contexts remain. Several factors on the demand and supply sides drive the pressures on water resources. A vast body of ongoing research has provided significant insight into different aspects of the problem and needs to be pursued with vigor. The impacts of climate change on the availability and quality of fresh water have only recently come into focus, and there is much less clarity and certainty about their manifold implications.

Climate change is neither a static nor a unidimensional phenomenon, and assumptions based upon past patterns could be misleading. To the contrary, certain threshold events could become more probable, and nonlinear changes should be expected. The extent and nature of prospective climate change in the South Asian region is a highly contentious issue, primarily because it has not been scientifically investigated in adequate depth. This is even more so when it comes to its impact on water resources, which are susceptible to a greater degree of vulnerability. Thus, there is a pressing need for a much bigger research program with a substantial input of human and financial resources.

One of the most fundamental elements of such a program must be to develop national- and regional-level climate change models distinct from the global models that have been the basis for future projections so far. To facilitate this, serious attention needs to be given to building a stronger and more accurate meteorological and hydrological database and to developing appropriate analytical tools for better forecasting and planning. It is equally important to capture the myriad dimensions of climate change impact through multidisciplinary studies into the relevant cross-cutting socioeconomic issues. For instance, many communities have long traditions of coping with extreme events such as droughts, floods, and cyclones. That local knowledge is invaluable for a fuller understanding of climatic risks and for evolving pragmatic responses. In fact, the involvement of the community is essential for the success of any strategy.

Given the commonality of water resources, the commonality of their utilization, and the commonality of the emergent issues, there is clearly a strong case for meaningful interaction between scientific institutions and water management agencies across the region. This would include information sharing, collaborative studies, capacity building, and technology exchange. Unfortunately, such cooperation is often stymied by mutual suspicion at the governmental level, with the result that instead of promoting many more joint research efforts, even basic data are shared reluctantly. An inclusive dialogue among policymakers, managers, scientists, and civil society would go a long way to bridge these chasms. With the growing realization that climate change is a reality that can be addressed only within an integrative framework, there is hope for a new approach toward policy formulation and regional cooperation.

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