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UNDERSTANDING PAKISTAN'S WATER-SECURITY NEXUS

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United States Institute of Peace

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About the Report

Focusing on Pakistan, this report, sponsored by the U.S. Institute of Peace, provides a preliminary analysis of water management within a critical national context.

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[In Pakistan, population growth, elite capture of public benefits, rapid urbanization, and shifts in production and consumption patterns have placed unprecedented stress on water resources.]

Summary

- Pakistan, a semiarid region and a primarily agricultural economy, is facing declining water availability and quality, growing water pollution, and overall environmental insecurity. This situation, coupled with institutional, operational, and governance failures, is fostering domestic discord.
- The water conflict has both historical roots and emerging dynamics.
- Water scarcity, floods, droughts, and domestic mismanagement can embitter interethnic relations and prompt political tension, which can in turn lead to violence.
- Understanding water availability, allocation mechanisms, and demand is critical to understanding national management challenges and security threats.
- A common response to the data on water supply and demand is to put it in the context of population growth. However, the greater issue concerns the politics of distribution, allocation, and access.
- Rapid urbanization, intersectoral competition, and a growing industrial infrastructure will increase the need both for water and for development of new water infrastructures.
- Climate change forecasts may seem like an antidote to water scarcity but may not have the same implications for water security—that is, human and socioeconomic security.
- Varying perceptions of water and security among stakeholders and decision makers are preventing viable solutions for effective water resource management.
- The current policy approach is oriented in supply-side interventions, and the overall ethos favors engineering megaprojects, a bias reflected in policy and in donor appeals. This approach only veils the problem of water use inefficiencies.
- Water stress should not be the tipping point but rather a means to promote social harmony, environmental sustainability, and national unity. Effective management can only come from domestic reform, and dependence on foreign aid will not render lasting solutions.
- It is crucial that the government invest greater political capital to regulate water competition and provide quality water services to all communities. Conservation will prove key.

Introduction

Pakistan is headed toward a serious water crisis. By 2030, experts expect this semiarid nation to decline from being water stressed to water scarce.[1] Because of overuse and misuse, the country is facing declining water availability and quality, growing water pollution, and overall environmental insecurity. In addition, its water and security nexus—which in this report refers primarily to human and socioeconomic security—is complicated by institutional inadequacies, a monochromatic supply-side vision, and a lack of substantive public participation in defining and solving problems. Water shortages may well pose the greatest future threat to the viability of Pakistan's economy.

Water is essential, whether for livelihoods, health, food security, or general economic development. In Pakistan, as in many parts of Asia, population growth, elite capture of public benefits, rapid urbanization, and shifts in production and consumption patterns have placed unprecedented stress on water resources.[2] Coupled with institutional, operational, and governance failures, increasing pressure over water use and misuse is fostering domestic discord. Although water is not a direct driver of conflict, it is an aggravating factor that threatens various dimensions of Pakistan's political fragility. Water is often used by communal, ethnic, and regional populations within the country to express discontent over the management of and increasing pressure on this most precious resource. Thus, understanding water availability, allocation mechanisms, variability, and demand is critical to understanding Pakistan's resource management challenges and security threats.

Much focus has been directed on Pakistan's interstate water issues with India and Afghanistan, but it is intrastate water tensions that are threatening domestic political and environmental security in an already fragile region. Intrastate conflicts can cause more damage and violence than interstate water disputes. The link to violent conflict is evident in institutionalized social stratification and recurrent episodes of dispossession and migration. Intrastate water disputes rarely gain the level of international attention that interstate conflicts do.[3] However, evidence from Pakistan is clear that water scarcity, floods, droughts, and domestic mismanagement can embitter interethnic relations and prompt political tension, which can in turn lead to violence. Diminishing water quality also leads to almost daily protests for better services. In a country that depends heavily on water for livelihoods, addressing water scarcity problems can alleviate much of the economic and social vulnerabilities that render Pakistan so unstable. Effectively managing water resources and use can create an avenue for rebuilding trust, confidence, and cooperation between the various water stakeholders. If water quality could be maintained, the paucity of water can be better managed and tensions may subside.[4]

Water scarcity, floods, droughts, and domestic mismanagement can embitter interethnic relations and prompt political tension, which can in turn lead to violence.

The country generally tackles its water scarcity problems by turning to supply-side approaches that focus on more storage and diversion. These approaches are not only costly but generate a spatial imbalance in resource distribution, adding to the mistrust over perceived excessive or inadequate water channeling between the country's water users, who already struggle with political enmity.[5] The combination of water scarcity and prospective demand pressures thus becomes a key driver for disputes to become violent.

Pakistan's water conflict has both historical roots and emerging dynamics. Historically, the key intrastate issue is water geography and the question of location along the head, middle, and tail reaches of the canals of the Indus basin irrigation system. When the British colonial administration initiated the construction of the system, they undertook not only a physical engineering enterprise but also a social engineering enterprise, where farmers belonging to

more "loyal" or supposedly distinguished tribes or castes were given preferential access to the head reaches of canals and watercourses; poorer and more marginal farmers were allotted lands in the tail reaches of the canals and watercourses. Because farmers located at the tail ends of canals have less assured access to water, they tend to be significantly less productive.[6] This water geography reinforces social stratification in irrigated rural canal colonies.

The occurrence of water-related environmental extremes, such as floods and droughts, accentuate this social stratification and highlight climate change as one of Pakistan's emerging threats. Environmental hazards have obvious implications for human and economic security, as illustrated by the recent 2010 floods and earlier by the decade-long drought in the southwest of the country.[7] But the ability of the government to respond to and prepare for these hazards raises a number of concerns for overall political security in terms of legitimacy and accountability. For example, some commentary has noted that belligerent groups have engaged in relief and recovery operations, raising a fear of such militant outfits leveraging their humanitarian activities to gain public approval, legitimacy, and ultimately recruits for their operations. Fear of militancy, though well-founded, can also have detrimental effects on legitimate recovery and aid efforts led by religious organizations.[8]

The domestically driven conflict over water in Pakistan needs to be better understood so that appropriate development strategies can be implemented.

Pakistan's Water-Security Nexus

Over the last decade, Pakistan became a water-stressed country: The United Nations (UN) currently estimates an annual per capita availability of 1,090 cubic meters.[9] The UN's Food and Agriculture Organization (FAO) measures the pressure on national water resources by calculating water withdrawal as a percentage of total renewable water resources (TRWR). Stresses are considered high if the TRWR value is above 25 percent. Pakistan's water pressure amounts to a staggering 74 percent. This pressure is exorbitant even compared with neighboring high-pressured countries, including India at 34 percent and Afghanistan at 31 percent.[10] The country is expected to become water scarce—less than five hundred cubic meters per capita per year—by 2035, some analysts even predicting by 2020. This alarming prediction is derived from a growing population, inefficient supply management, distribution inequalities, and the effects of climate change. Despite uncertainty surrounding how quickly water resources are being depleted and what future populations and industries may need, it is clear that Indus basin water is precarious.

Stresses are considered high if the TRWR value is above 25 percent. Pakistan's water pressure amounts to a staggering 74 percent.

Security in the context of this study refers both to national security, in terms of direct conflict and violence between different groups and users, and to human security, defined as an individual's security from environmental extremes and social instability. Water is the material basis of existence, livelihoods, and production, and lack of access adversely affects not only human security but also social stability. Human security and social instability typically manifest themselves at the subnational scale.

Water supply, as a historically produced condition, is not merely the amount of snowpack or precipitation in a given year. It is also the technological systems and institutions governing those systems, developed by society to access this resource. Although the absolute quantity of water available is clearly an important number, the social systems constructed to access that water are having a disproportionate impact on the regions and people who actually get water. Pakistan's water scarcity problems are thus synonymous with its struggle with poverty and inequality in the distribution of water across regions and between social classes.

Intrastate water tensions and challenges are deeply linked with agriculture. This sector has seen production growth over the last few decades, but it is rife with inefficiency and mismanagement. Water constraints will require changes in the types of food produced as well as more efficient irrigation practices that improve water quality. About 80 percent of cultivated land in Pakistan is irrigated, of which about 33 percent is affected by waterlogging and soil salinity, leading to significant declines (an estimated 25 percent) in crop yields, especially downstream. These issues will remain problematic until more sustainable irrigation practices are put in place.

Due to Pakistan's increase of commercial agriculture, a growing number of small and tenant farmers are being thrown off the land and are migrating to urban and peri-urban areas.[11] Water is not the root cause, but it is directly linked to land rights and compounds problems of rural dispossession. Comments during field interviews suggested that most extremist outfits in central and southern Punjab province, where land holdings are most skewed, rely on these armies of dispossessed small farmers to fill their ranks. Furthermore, common criminality in Pakistan is thought to be associated with this process of rural dispossession. This is not surprising, given that the mostly rural populations, of whom 40 percent are in poverty and 50 percent are landless, depend on the irrigated agriculture for their livelihoods.[12]

Field interviews suggested that most extremist outfits in central and southern Punjab province rely on these armies of dispossessed small farmers to fill their ranks.

Urban water supply and sanitation is another security concern. Pakistan is home to eight cities with populations of more than one million, including the megalopolis of Karachi, which produces more than a quarter of the country's gross domestic product (GDP). Water-related riots as a result of poor water and sanitation services are not unknown, and "water mafias" often operate in collusion with criminal elements in the urban areas, especially in Karachi.[13] Poor access to water supply and sanitation has obvious consequences for human security, and diminished security runs the risk of evolving into civil unrest and political instability.

Groundwater depletion, particularly in southwestern Balochistan province, is also a major warning sign of a looming crisis.[14] Pakistan is currently withdrawing 83 percent of its total renewable groundwater.[15] Wholesale promotion and then adoption of electric water pumps for groundwater tapping in the province has meant destruction of traditional *karez* irrigation systems and the communities and the social capital that crystallized around them.[16] Again, initial field interviews suggest that many young men released from local communal bonds as a result of the destruction of local livelihoods and ensuing rural-to-urban migration may be joining militant outfits in Pakistan and neighboring Afghanistan. However, the validity of these statements needs further investigation.

Another major source of trouble is interprovincial water conflict, often leveraged by ethnonationalist movements to arouse passions and at times to justify separatist agendas. Water conflict between the economically and geographically dominant upper riparian Punjab province and the lower riparian Sindh province over the distribution of the Indus River and its tributaries is one of the most notorious in the country.[17]

Ongoing arguments over royalties from dams and dam construction between the Punjab and the Khyber Pakhtunkhwa (KPK) province, however, must be evaluated in light of the political economic effects of recent changes in federal structure.[18] Passage of the 18th Amendment in 2010, which gave more autonomy to the provinces, failed to address the underlying causes of provincial water disputes and resulted only in discontinuities in water management structures. The ensuing complexities in governance show how the provinces proved to be unprepared to handle the problems of water quality, allocation, and distribution.

Finally, climate change has the potential to shift the dynamics of the water-security nexus. Extreme weather events and shifts in water supply patterns could add more pressure to each

of the anticipated security concerns, highlighting the need for a comprehensive disaster risk management strategy integrated into a national water policy. Because Pakistan is a predominantly agricultural economy, any decrease in crop yields will affect not only livelihoods but also food security in both rural and urban populations. Such insecurity runs the risk of aggravating existing social inequalities in water use and availability and intensifying the sociopolitical factors that imperil Pakistan today. Although more or less isolated now, these flashpoints could heighten the reactions of disgruntled groups unless sustainable and efficient practices are implemented.

Water Availability, Variability, and Demand

Pakistan is one of the most arid countries in the world. Most of its water supply comes from a single source, the Indus system, which is composed of six major tributaries: the Indus, Chenab, Jhelum, Ravi, Beas, and Sutlej (see map 1). Glacier melt, snowmelt, rainfall, and runoff supply river flows. Rainfall averages around 494 mm a year[19] and derives mainly from summer monsoons. Precipitation is unevenly distributed and greatly varies by season. The estimated long-term basin-wide surface water availability is approximately 194 to 209 million acre-feet (MAF), of which 142 MAF is extracted in Pakistan.[20] Average renewable water availability is about 154 MAF, of which 45 MAF is from groundwater.

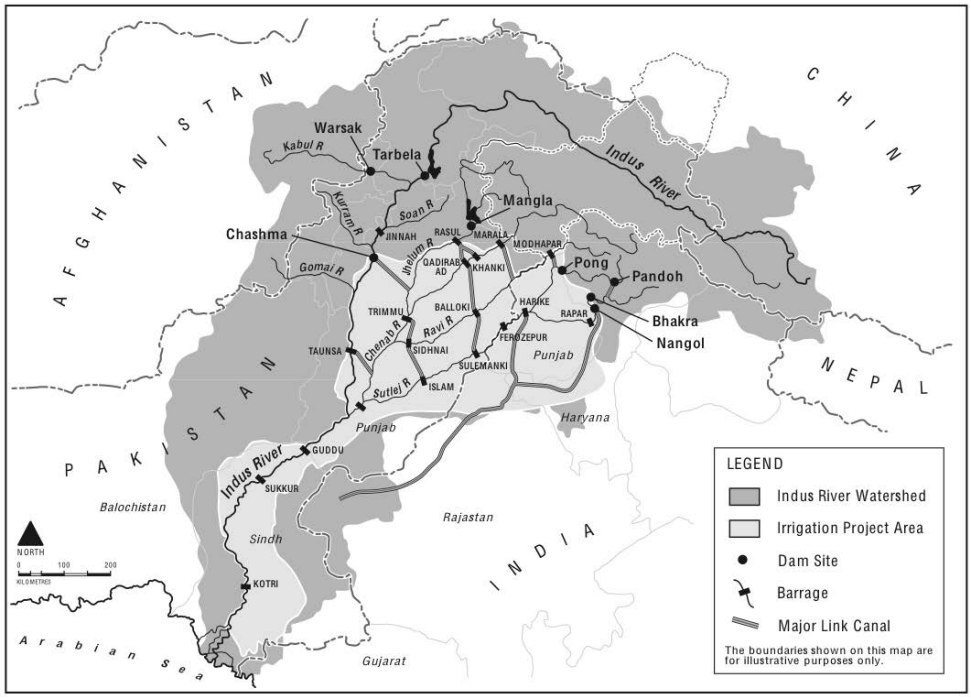
The Indus basin system is the largest contiguously irrigated area in the world.

To historicize water supply, the analytical focus must first shift from ecological reservoirs of fresh water to the physical structures society constructed to access that water and then to groundwater aquifers. The most important aspect of the agricultural water supply system in Pakistan is the extensive surface canal irrigation system, the foundation of which was laid during British colonial rule. The Indus basin system is the largest contiguously irrigated area in the world. By any measure, it is also the product of one of the largest hydraulic interventions in history. The canal colonies of southwest and central Punjab were the centerpiece of a massive social engineering project that built thousands of miles of canals between 1885 and 1947 in an arid landscape. More than one million people migrated to the nine canal colonies, and the region is today one of the most densely populated and agriculturally productive in South Asia.

British colonial rule was followed by decades of disputes over water infrastructure and allocations between Pakistan and India. To preempt any water wars, the two countries signed the Indus Water Treaty (IWT) in 1960. The agreement divides the Indus River system into the Western Rivers—composed of the main stem of the Indus, the Jhelum, and the Chenab—and the Eastern Rivers—the Ravi, the Beas, and the Sutlej. An average of about 138 MAF flows annually into Pakistan in the Western Rivers. The vast majority of surface water extractions are made from the Western Rivers, where flows are measured by "rim stations"—at Kalabagh for the Indus, Mangla for the Jhelum, and Marala for the Chenab. More than 80 percent of the annual flow of the Western Rivers occurs in the three *kharif* (summer) months.

The irrigation system was designed to deliver minimal water to sustain enough agricultural production for famine prevention. The Canal and Drainage Act of 1873 legally mandates enough water delivery to sustain 64 percent cropping intensity.[21] Today, real cropping intensities are between 150 and 200 percent, thanks partially to Green Revolution technologies. However, this increased production had adverse effects. Economic power was concentrated in two ways: horizontally across regions and vertically across class structures. Rich farms became richer, because they could tap the capital-intensive technology package of the Green Revolution. Poor farmers became poorer, because their farms could not compete with the more productive farmers. Agrarian workers, those who did not formally own land, perhaps suffered

Map 1. Indus Basin Irrigation System Major Rivers and Infrastructure



the greatest loss in security of livelihood because machines increasingly replaced their labor. The number of tenant farms was cut by half between 1960 and 1990, and the landless rural population working as wage labor in Pakistan swelled to about 40 percent of the rural population. The result was a complex chain of circular and permanent migration from the Pakistani countryside to urban centers.

Access to irrigation water in the Indus basin in Pakistan cannot be separated from access to land. Unlike in other arid regions, where water rights can be bought and sold separately from land, such as in the western United States and in groundwater-based irrigation systems in Afghanistan and Balochistan, water rights in the Indus basin are linked to land ownership. British development policy for the canal colonies favored certain segments of society over others through land grants. This preference for landed notables continues to define the social reality of access to water in rural Pakistan today.[22]

Water rights in the Indus basin are linked to land ownership. This preference for landed notables continues to define the social reality of access to water in rural Pakistan today.

Current water withdrawals in Pakistan total about 142 MAF. Approximately 71 percent of withdrawals are from surface water and 29 percent from subsurface groundwater. Withdrawals from surface water account for about 74 percent of the total surface water available, and withdrawals from groundwater account for 83 percent of total renewable groundwater available.[23]

River flows in Pakistan are highly uneven temporally, and year-round agricultural requirements depend on adequate storage capacity.[24] However, the Indus' massive irrigation system has a storage capacity of only 121 MAF per year, or a thirty-day supply.[25] This capacity is extremely low given that India can store for 120 to 220 days, Egypt up to 700 days, and the United States for 900 days.

A little less than half of Pakistan's population depends on irrigated agriculture for their livelihoods, and one-third lacks access to safe drinking water. Pakistan is often referred to as a hydraulic economy[26] because of its vast economic dependence on irrigated agriculture, which accounts directly for a quarter of the country's GDP and directly or indirectly provides 60 per-

cent of the population with their livelihoods. Ninety-seven percent of annual available surface water goes toward irrigation to support agriculture.

The UN estimates that water demand in Pakistan is growing at an annual rate of 10 percent.

Because Pakistan's transition to an urban and industrial economy is likely to continue, its competition with agriculture for water resources is likely to increase. Evidence points to a widening gap between water supply and demand. The UN estimates that water demand in Pakistan is growing at an annual rate of 10 percent.[27] That is, demand is projected to rise to 274 MAF by 2025. This said, total water availability by 2025 is not likely to change from the current 191 MAF. This gap of about 81 MAF is almost two-thirds of the entire Indus River system's current annual average flow.[28]

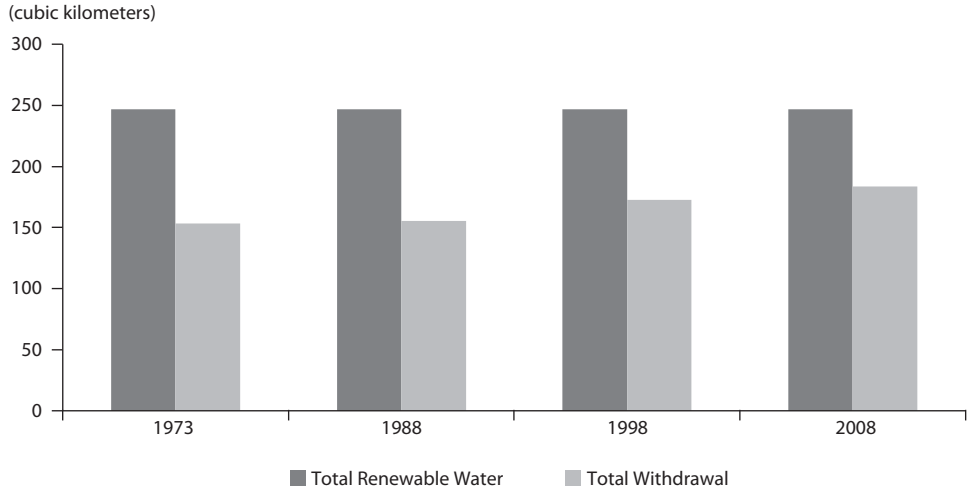
The main source of drinking water in Pakistan comes from groundwater. Below the rim of the Himalayas lies one of the largest freshwater aquifers in the world. The groundwater footprint for the Upper Ganges Aquifer, which sustains both India and Pakistan, is more than fifty times its size and is one of the most overexploited aquifers in the world.[29] Pakistan's subsurface groundwater resources amount to about 51 MAF,[30] most of which lie in Punjab. A substantial amount of the available water diverted in the Indus basin canal system refills the groundwater reservoir. Farmers depend on groundwater to supply about 40 percent of their irrigation water demands.

Rates of groundwater exploitation have increased rapidly in the past several decades, and some areas, mainly Balochistan, are mining aquifers beyond their capacity for natural replenishment.[31] Aquifer mining is supplementing the surface water that reaches Pakistan's farmland, but this indiscriminate pumping and heavy use of pesticides are contaminating the aquifer, where tubewell water salinity is increasing.[32] Although evidence of exploitation is clear, tens of thousands of additional wells continue to be serviced every year. Both the government and donors have failed to reengineer their capacity and funding to deal with groundwater depletion.[33]

The total amount of water available in the Indus system depends ultimately on precipitation, but the timing of the availability of this precipitation as useable water flow depends on other factors, such as the precipitation captured by snowfields in the winter and how much is released as melt water in the summer. Although glaciers cover less than 2 percent of the total area of the Indus river system basin,[34] they contribute 40 to 50 percent of the water used downstream in Pakistan. Despite the consensus among scientists on the crucial contribution of melt water in the Indus, the question of what is expected from this source of water in the context of global climate change is debated. Rainfall in the Indus basin is highly concentrated temporally, falling largely in monsoon summer months. Less certain is how climate affects monsoonal patterns, mostly because not enough data are available to run global circulation models to account for regional variation, just as monsoon dynamics are not well enough understood for scientists to model them.

Debate is considerable on how fast Himalayan glacier retreat is occurring and the extent to which it will affect Pakistan and other South Asian countries. Some analysts argue that deglacialization in the western Himalayas and the Karakoram Mountains in the north of Pakistan has already started, and that the eventual outcome will be reduced river runoff.[35] These analysts also argue that before average annual river runoff decreases, increased peak flooding in the summer months is likely, which could be interpreted as both a hazard and an opportunity.[36] The phenomenon of glacier lake outburst flooding induced by climate change is also becoming a concern in northern Pakistan because it causes sudden catastrophic flooding in large areas and greatly threatens the lives and livelihoods of local communities. With these outbursts, a vital source of irrigation is also lost.

Figure 1. Water Availability and Withdrawal



Source: FAO, AQUASTAT database, 2013.

The Intergovernmental Panel on Climate Change (IPCC) forecasts an increase in the number of rainy days in South Asia and in the number of extreme events as a result of climate change.[37] More precipitation seems like an antidote to the threat of water scarcity, but it might not have the same implications for water security. More extreme precipitation events could lead to more severe landscape hazards.[38] Indeed, rainfall is more likely to add water more intensely or over a shorter time, leading to the danger of flooding. Interannual variability in the monsoon, even if it means more rainfall some years, is also the chronic scourge of farmers in South Asia, especially the arid northwest.[39] Others stress that regional information is still too scant for meaningful monsoonal change forecasts.[40] The effects of climate change on water resources will be most significant and visible in the way climate change interacts with glacial melt and monsoonal patterns, but scientific knowledge of these systems does not allow sufficient predictive models.

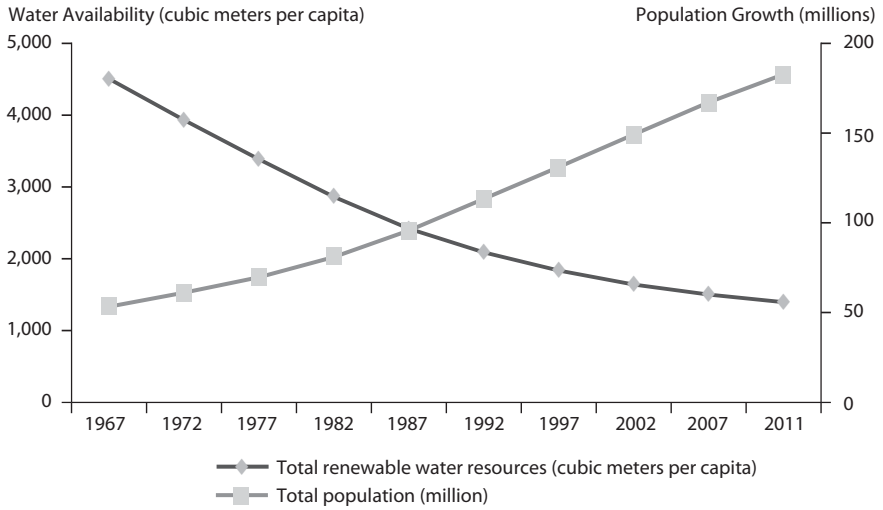
A common response to the data on water supply and demand is to put it in the context of population growth. The most likely increase in future demand for water in Pakistan will come from cities. Population growth has been high, averaging an annual rate of just over 2.5 percent. Most writing on the country's water scarcity and water policy in general begins with the sobering fact that the per capita availability of water in Pakistan has decreased from 5,260 cubic meters in 1951 to roughly 1,040 in 2010,[41] a decline of more than 400 percent. Figures 1 and 2 show the relationships between water availability, withdrawal, and population.

The per capita availability of water in Pakistan has decreased from 5,260 cubic meters in 1951 to roughly 1,040 in 2010, a decline of more than 400 percent.

Pakistan is currently the sixth most populous country in the world, and its population is expected to increase from 180 million in 2012 to 230 million in 2025.[42] Domestic water needs amount to about 100 liters per day, and food production requires between 3,000 and 5,000 liters.[43] Theoretically, the agricultural sector will have to grow more than 4 percent annually to meet the food requirements of the increased population.[44] However, the assumption that population growth will outstrip the capacity to produce enough food for everyone is not the source of a pending national crisis. The issue lies in the politics of distribution, allocation, and access—not in aggregate supply and demand.[45]

As previously mentioned, Pakistan had an average annual population growth rate of 2.61 percent from 1961 to 2011. That the average population growth rate was only 1.81 percent from

Figure 2. Water Availability and Population Growth, 1967–2011



Source: FAO, AQUASTAT database, 2013.

2001 to 2011 suggests that population is growing at a declining rate, however. More important, total crop production grew by an annual average growth rate of 3 percent for roughly the same period, from 1962 to 2010,[46] and the annual food production index grew at an even larger rate of 3.4 percent. Per capita caloric intake has increased from 1,812 calories per person between 1961 and 1963 to 2,340 calories between 2001 and 2003.[47]

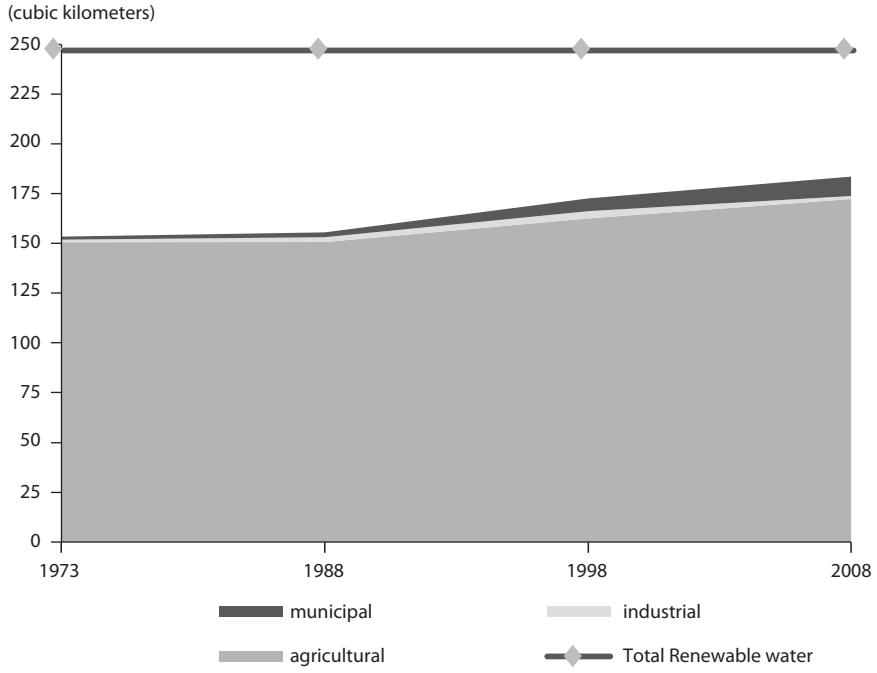
Despite this abundance, as of 2008, 25 percent of the country's population are estimated to be undernourished. In other words, there is more than enough to go around, but the social and material infrastructure that distributes food and water across society is exclusionary. The slowdown in agricultural production in the first decade of the 2000s, however, is worrying.[48] Nevertheless, the main question is not how to increase the supply (or decrease the demand) of water but how to share it more equally. To speak of deprivation stemming from absolute water scarcity without taking into account the extreme social and geographical differentiation in the population is to fatally disregard how people actually access the goods they need and want.

The main question is not how to increase the supply (or decrease the demand) of water but how to share it more equally.

Rapid urbanization is likely to become increasingly controversial when it comes to the allocation of water. Industrial and domestic water demand is a tiny proportion of the overall water demand situation in Pakistan, as evident in figure 3, but given the numbers of people who depend on the domestic water sector and the spatially concentrated effects of industrial and domestic water demand, the political consequences of the present situation and future trends are likely to be out of proportion to the proportional volume of water involved for each sector. Load shedding greatly affects water pumping, and power shortages are directly related to water shortages in many cities. Without an integrated approach for water demand management, water shortages will continue to plague all sectors and have significant negative economic repercussions.[49]

One study attempted to model future water demand in the industrial sector under high (roughly 10 percent), medium (about 7 percent), and low (just under 3 percent) annual economic growth scenarios from 2010 through 2030.[50] This modeling study indicated that under each scenario, the water demand is likely to increase by 2.2, 1.3, and 0.8 times the baseline of 2010 respectively. The reduction in the water demand in the low development scenario is based on the model assumption of technological advances increasing the productivity of water over

Figure 3. Current Water Withdrawal by Sector



Source: FAO, AQUASTAT database, 2013.

time. Unlike the agricultural sector, it is highly likely to expect substantial gains from technological advances. The study further modeled the industrial water demand proportions by industry until 2030, assuming that the existing industrial structure will continue to be based heavily on textiles. The textile sector will account for almost 70 percent of water demand, chemicals for 10 percent, and other industries for 20 percent.

What this modeling attempts to demonstrate is that rapid urbanization and the growing number of industrial units in Pakistan will increase the need for development of new water infrastructures. Little research has been done on the changes in Pakistan's water use as a result of economic activities and industrial production. Yet as table 1 shows, the prediction is that demand in all sectors will exceed supply.

The concern about industrial water demand may not be as much about volume as about localized pollution from certain industries and their effect on public health and ecosystem services that poor people depend on. Some studies paint a dreary picture of the pervasive pollution of water bodies around industrial estates and urban areas with heavy metals and untreated sewerage. Around 90 percent of industrial and municipal waste, which is largely untreated and often highly toxic, is dumped into open drains and filtrated into aquifers. Natural aquifer cleansing takes decades, even centuries. Furthermore, in Pakistan, which has the twenty-sixth highest infant mortality rate in the world, more than 60 percent of those deaths are caused by waterborne diseases. The effects of water pollution on public health and human security are obvious. Whether they will also translate into threats to peace is an open question.

Around 90 percent of industrial and municipal waste, which is largely untreated and often highly toxic, is dumped into open drains and filtrated into aquifers.

In terms of volume, Pakistan seems to be well endowed with water resources. In terms of per capita availability, the water supply picture may seem worrying. More than the absolute volume, however, is the temporal, spatial, and social distribution of water, which ought to be of greater concern. Water security problems in the country are often presented as an excess of de-

Table 1. Nonagricultural Water Needs (millions of acre-feet)

	Year		
	2000	2025	Additional Requirements
Water supply and sanitation	4.5	10.5	6.0
Industry	2.2	3.5	1.3
Environmental protection	1.3	1.7	0.4
Total	8.0	15.7	7.7

Source: Authors' compilation based on Government of Pakistan, *National Water Policy.*

mand over supply, but a deeper understanding of water scarcity must historically contextualize systems of supply and demand. In other words, water supply and demand are not exogenous variables. Rather, the magnitude and nature of supply and demand in any given region have developed as a part of a region's history and geography. Water supply and demand are important in considering water security, not just because of the necessity of respecting absolute ecological thresholds but also because effective policy changes must recognize their deeply social nature. The historical and political economic context through which water demand and supply are established gives us the means to reframe the water scarcity debate and, thus, the connection between water scarcity and water security.

Water and Security Threats

Pakistan's water pressures are only compounding the country's volatility and rampant instability. Protests occur almost daily in cities over insufficient access to clean water. Farmers and landowners feud, sometimes violently, over water rights and lost livelihoods. Any diversion of or development on upstream waters becomes an ethnic conflict between provinces. Increasing scarcity and environmental hazards are displacing the most vulnerable communities, leaving them in even worse social and economic conditions. Dispossession runs the risk of political destabilization and greater recruitment opportunities for extremist groups. If no significant national policy and development strategy or clear laws and regulations that monitor water use are established, unemployment, poverty, and food insecurity are likely to increase and could become recruitment grounds for extremism. Climate change and rural-urban migration will only exacerbate this problem. The following flashpoints describe areas where water either causes or intensifies insecurity. They do not isolate water as the driver of, or sole factor in, these issues.

Increasing scarcity and environmental hazards are displacing the most vulnerable communities, leaving them in even worse social and economic conditions.

Interprovincial Disputes

The Indus basin irrigation system legitimately draws the bulk of attention and investment by Pakistani water managers and international donors. Greater attention, however, is needed on regional variations between provinces and how water issues might align with ethno-nationalist sentiment to become security concerns. The seemingly perpetual water conflict between Sindh and Punjab reached a tentative settlement with the Inter-Provincial Water Accord of 1991, signed by all four provincial governments, which were governed by the same political party for the first time. The accord was based on the assumed average flow of 114.35 MAF in the Indus system and allocated 55.94 MAF to Punjab and 48.76 MAF to Sindh province. The legitimacy of the accord was in question primarily because the negotiating process was not transparent and did not include all the stakeholders, particularly from the smaller provinces, and because of the suspect legitimacy of the political setup in Sindh province at the time. Furthermore, even the

official figures for average annual flows for the Indus basin and subsequent justifications for additional storage on the Indus river, particularly the Kalabagh dam, are suspect. Many analysts now argue against the official methodology of using the higher number for flows in the Indus system, particularly because it is based on a shorter time frame—that is, since 1977—and because the higher number works to the disadvantage of downstream riparian Sindh province.

Hydroelectric development is controversial because it invariably displaces riparian communities. However, the rising pressure on Pakistan's energy and agriculture sectors inevitably brings the significance of this type of development to the forefront of policy debates. The connections between energy and water thus become an aggravating factor in provincial disputes. The official argument in favor of the construction of the Kalabagh dam on the Indus River paints the picture of a scarce, wasted water resource being allowed to flow out to sea and outlines a doomsday scenario should additional storage not be built.[51] The controversy is beginning to polarize public opinion, particularly in Sindh province, where the dam controversy is perceived as yet another insult to the long series of injuries inflicted on them by Punjab province through its appropriation of Sindh's rightful share of water. The dam is also opposed by Pashtun nationalist parties, such as the governing Awami National Party in KPK, for fear that its reservoir will flood rich farmland in the province. In addition, Balochistan province has come out against the dam because of concerns about adverse impacts on the Pat Feeder Canal from the Indus in its territory. However, in no other province is the intensity of antidam emotion matched with that in Sindh. Given the depth of feelings in Sindh against Kalabagh, any initiative to start construction of the dam by the democratically elected, but Punjabi-dominated, government or by a military dominated nationalist government could precipitate intense hostility in Sindh.

The connections between energy and water become an aggravating factor in provincial disputes.

Sindh and other provinces have acquiesced to the construction of the Bhasha Dam in the upper Indus, upstream from Tarbela. The government is moving forward with initial preparations for its construction. However, a drought in lower Pakistan, such as that of the late 1990s after the construction of the dam, could flame the perception that Bhasha is part of the problem. In such a scenario, intense civil unrest is possible in Sindh, similar to the speculation of unrest in Kalabagh. Construction of the dam in the most seismically active zone in the world raises important questions of safety. Dam failure is a nightmare scenario and could easily be used by ethno-nationalist elements—in Sindh, in particular—to further their agendas.

Groundwater Depletion

The water-security nexus of high dependence on groundwater is most obvious in Balochistan, an especially arid province. The region has been the focus of world attention because of the ongoing Taliban insurgency in Afghanistan, the border regions of Pakistan, and the links of the insurgencies to international militant Islamist networks. Very little attention has been paid to the regional rural political economy and its possible linkages to the geographies of violence in the region. Baloch insurgency is also about provincial autonomy and control over its natural resources. Thus, groundwater depletion in Balochistan is likely to have unexamined consequences for the social stability of the province and perhaps even geopolitical stability in the region.

The groundwater situation in Balochistan is already tenuous, and the ongoing insurgency in the province is not helping. If the groundwater keeps declining at current rates and laws regulating groundwater pumping continue to be flouted, groundwater may run out in the urbanized Quetta valley. The Pakistan army, which has large installations in the valley, already

has contingency plans for evacuating its installations should the water situation worsen there. Groundwater depletions have already had some adverse social consequences in Balochistan.

The economy of Balochistan has always been heavily rural and dependent on agro-pastoralist activities. Because the province lies in an arid zone, the region is almost entirely dependent on groundwater to sustain agriculture and rural livelihoods.[52] The main conduit for tapping groundwater had been the traditional *karez* system. A karez is an underground aqueduct that passively taps the groundwater in the piedmont and carries the water by gravity to the "daylight point," where the water is then channeled into irrigation ditches for agricultural and domestic uses. The system is environmentally sustainable because it only passively taps the groundwater and cannot cause overdraft, unlike electric pumps. Beyond the importance of environmental sustainability is the significant social capital that crystallizes around the infrastructure of a karez.[53] These require a high level of social organization and collective effort for their routine maintenance and administration of water rights, which are almost like property rights, and can be bought and sold independent from land. The region might be one of the few places in South Asia where most rural farmers do not know the extent of their land holdings because land is so abundant. However, they do have a precise knowledge of their water rights, from which they derive their status and identity within a community. In essence, the karez system has been virtual glue holding the rural Baloch and Afghan society together, as well as providing a buffer during frequent droughts in the region.

In the name of agricultural modernization, electric water pumps were introduced to the region in the last three decades of the twentieth century, along with heavy subsidies of electricity for their use.[54] Many of the larger, more powerful farmers in the region were able to access these tubewells and expand agricultural production. However, the electric tubewells have led to rapid declines in the water table, particularly in Pakistani and Iranian Balochistan, leading to the decline of the karez system.[55] Even though the agricultural production is increasing, many of the old karez shareholders' water shares are becoming unviable because their karezes have gone dry. Karez was not just a source of livelihood but also the basis of identity and status in the community. Once a water right was lost, people lost their social status and often had to migrate to nearby cities or take up jobs as farm laborers with tubewell owners. The consequence has been a breakdown of community cohesion and the social capital that coalesced around the karez system. It is highly likely that the breakdown in the karez-based social capital is, in fact, creating armies of young people outside of community structures. This social disintegration runs the risk of contributing foot soldiers for assorted insurgent outfits in the region.[56]

Migration and Urbanization

At the local level, water conflicts and constructed scarcities are likely to have even more serious consequences for national stability in the future. Small and tenant farmer dispossession and the inherent nature of the institutional structure of the irrigation system create conditions with considerable law and order problems and will likely continue to do so in the future. Increasing dispossession of small and tenant farmers could further swell the numbers of landless peasants migrating to urban slums. In the absence of employment opportunities for such migrants, increased urban unrest of the type witnessed every day in Karachi could spread to other large cities. Institutionally driven water scarcity in the irrigation system would have consequences not just in terms of rural to urban migration but could also lead to rural unrest. Some of that unrest was channeled by the intelligence agencies in the 1980s and 1990s in southern Punjab toward mobilizing armies of radicalized young men for jihad in Kashmir and then Afghanistan. The

Increasing dispossession of small and tenant farmers could further swell the numbers of landless peasants migrating to urban slums.

same unrest in the future with a greater number of people does not bode well for stability in rural Pakistan either.

In terms of surface water, Pakistan depends on a gravity-based irrigation system. In such systems, location of one's plot of land along a water course is the arbiter of whether one gets water or doesn't. Again, research undertaken in the Indus basin indicates that geographies of access to irrigation are very much congruent with geographies of social power.[57] Smaller farmers tend to be at a disadvantage strategically when it comes to accessing water and are also more vulnerable to flood hazards.[58] Due to the linkage of land and water rights, the trend of tenant and small farmer dispossession is partly the outcome of their vulnerable location at the tail end of canal commands and watercourses and partly their inability to invest in and maintain groundwater pumps. Armies of rural poor migrating to cities or loitering in rural areas have proven rich grounds for recruitment by extremist outfits. It is not a coincidence that most of the so-called Punjabi Taliban and militant sectarian outfits draw the majority of their recruits from southern Punjab, where such rural dispossession is highest and the land distribution is most skewed, in comparison to the rest of Pakistan.

In a gravity-based irrigation system . . . location of one's plot of land along a water course is the arbiter of whether one gets water or doesn't.

With the highest urbanization rates in Asia,[59] water and sanitation provisions within and between urban communities in Pakistan threaten water and security at the local level. This nexus manifests itself through violent protest over water and sanitation allocation and distribution, criminal gang monopoly over water sources in urban Pakistan, exploitation of the most vulnerable, gender-based violence, and the dangerous health impacts of contaminated water supplies. Water and sanitation provisions are critically and increasingly interlinked with human security in South Asia. Access to water and sanitation is increasingly being perceived as a right and an essential part of the social contract between the citizens and the state. Populations in Pakistan are accordingly negotiating access in both nonviolent and violent forms.[60]

The megalopolis of Karachi in southern Pakistan saw many violent riots in the late 1990s and early 2000s, particularly in its informal settlements (kaatchi abaadis) like Lyari. Residents of Lyari attribute their biggest problem to water access, or lack of it, which only inflames their discontent with governance structures. The settlement is supposed to receive five million gallons of water per day, yet research has shown the actual daily figure at thirty thousand gallons. One explanation for this discrepancy is corruption and illegal diversions of the supply to high-income settlements served by the same system.[61] As a result, frustrated residents have staged several protests, which have developed into water riots, which are increasing in frequency. The offices of the Karachi Water and Sewage Agency, the government agency responsible for provisions, are increasingly subjected to violent attacks. In 2001 and 2003, residents of Lyari came onto the streets to protest regular and severe water shortages in their homes. When police responded to the four thousand protestors with force in 2001, violent reaction in the subsequent days led to three bombs exploding in the city, dozens of cars set on fire, and 230 people arrested. Two people were killed and several were injured during the violence.[62] Such incidents are becoming a frequent occurrence in Karachi. In June 2010, after politicians in the Sindh Provincial Assembly unsuccessfully called on the Pakistan government to address contamination and shortages of drinking water in their district, Lyari residents again erupted into violent protest, which the police responded to with tear gas and baton charges. Recurring drought, exacerbated by climate change, is only making the risk of water protests and violent riots more likely.[63]

One of the most common sources of access in Pakistan has become the water tanker.[64] Tankers are often owned by a water mafia, which charges extortionate rates or finds ways to cut supply from government and private sector actors, creating an artificial need for water.

The power and control of the water tank mafia has been documented in Karachi, where it has worked in league with corrupt public servants.[65] One of the more insidious consequences of the long-standing arrangements between local politicians and the tanker lobby is to permanently delay the construction of new water infrastructure. For example, the Rangers, a paramilitary force in Karachi that has a strong presence in the metropolis to control law and order, are also involved in supplying domestic water through tankers and use it as a means of generating revenues in addition to leveraging control over local communities. Many political parties in the metropolis do the same.[66]

Water contamination causes serious health problems, particularly for women and children. Furthermore, although water crises affect women and men in different ways, it has been widely argued that women suffer disproportionately.[67] The human security of women and children has been adversely affected in particular, because they are responsible for collecting water and are often unable to leave the boundaries of their villages due to cultural reasons, whereas men can travel further to obtain safer sources.[68] The human capital effects of water-related environmental risks amount to at least half of the country's wage losses of 8.8 percent of GDP.[69] The outbreak of dengue fever in Pakistan in the summers of 2011 and 2012 caused considerable public outcry, particularly in the provincial capital of Lahore.[70] In the light of climate change and continuing poor water drainage and sanitation conditions, the threat to public health in Pakistan from waterborne diseases is likely to be further accentuated.

Security is not only linked to water in Pakistan at the international and provincial scales. The water and sanitation access that is negotiated and often fought for at the local level has resulted in violent repercussions that threaten the security of the individual and law and order in Pakistani cities and communities. More focus on anticorruption measures in water and sanitation service delivery in growing metropolises and on water as a right may help prevent simmering tensions over lack of access from turning into violent riots. Table 2 illustrates some recent examples of water-related conflicts in Pakistan.[71]

Climate Change and Environmental Hazards

Scientific uncertainty regarding glacier retreat and consequent long-term water availability in Pakistan is considerable. Analysts tend to agree that past patterns and timings of water availability are unlikely to continue into the future. The key climate change challenges in the Pakistani water sector are timing, location, and intensity of flood and drought hazards, which affect economic security and test institutional response and preparedness.

Recent floods are a stark reminder of the type of challenges and the level of natural disaster intensity that climate change could bring.

The recent floods are a stark reminder of the type of challenges and the level of natural disaster intensity that climate change could bring. In 2010, the country saw unprecedented monsoon rainfall in the northwest of the country, an area outside the monsoon zone. Populations and infrastructure that had never been exposed to those levels of precipitation suffered equally unprecedented damage. More than 21 million people were affected and about 1.8 million homes damaged or destroyed.[72]

Floods in Pakistan are generally man-made phenomena, largely because of the highly regulated hydrology of the basin. Most major inundations of human habitations in the basin are a consequence of the breaching of side levees to release pressure on barrages and other diversionary infrastructure in the basin during floods. The operation of breaching sections has been deemed a purely technical matter, but more often than not it is also a political process. All infrastructure in the basin has a safe designed capacity for the flow of water, and once that capacity is exceeded, a breaching section upstream from the barrage is operated to re-

Table 2. Recent Incidents of Water Violence and Conflict in Pakistan

Year	Location	Level of Conflict	Type of Conflict	Description
1900s—present	Punjab, Sindh, Balochistan, Khyber Pakhtunkhwa	provincial	water allocation	Protests and legislative disputes over water allocations; accusations of stealing water.
2001	Karachi, Sindh	municipal and provincial	service delivery and development	Civil unrest over severe water shortages resulted in riots, four bombs in Karachi (June 13), one death, twelve injuries, and thirty arrests. Ethnic conflicts ensue over accusations that the government favors Punjab over Sindh in water distribution.
2002	Mirpur City, Kashmir Region	municipal	development	Violent protests break out over Mangla Dam construction, twelve injured.
2003	Karachi, Sindh	municipal	development	Police used force to break up protests over water shortages, twelve injuries.
2003	Okara District, Punjab	national	service delivery	During a siege against a tenant farmer uprising after a farmer was killed, Pakistan Rangers, a paramilitary force, closed water canals to two villages, destroying their entire summer crop.
2004	South Waziristan Tribal Areas, Khyber Pakhtunkhwa	national	terrorism	In military action aimed at Islamic terrorists, including al-Qaeda and the Islamic Movement of Uzbekistan, homes, schools, and water wells were damaged and destroyed.
2005	Shahdadkot, Sindh	community	water allocation	An armed group of men killed five people because of differences over irrigation water
2006	Federally Administered Tribal Areas	community	water allocation	Water war between Boshehra and Malikhel tribes killed fourteen, wounded thirty-five.
2008	Peshawar, Khyber Pakhtunkhwa	national	terrorism	In October, the Taliban threatened to blow up Warsak Dam, the main water supply for Peshawar, during a government offensive in the region.
2010	Hangu District, Khyber Pakhtunkhwa	community	water allocation	A water dispute between the Wazir and Bangash tribes killed six, injured three.
2010	Harnai District, Balochistan	community	water allocation	A water dispute between two rival groups of a tribe led to two deaths, three injuries.
2010	Federally Administered Tribal Areas	community	water allocation	September saw two weeks of fighting over water, in which the Mangal tribe stopped water irrigation on lands used by the Tori tribe; 116 deaths and 165 injured.
2011	Sindh, Punjab	municipal	service delivery	Protests turned violent over power and water outages across the country.
2012	Sindh, Punjab	municipal, provincial	service delivery	Civil unrest and protests over power and water outages led to property destruction and violent encounters with police.

lieve pressure. The capacity of the infrastructure on paper is typically a conservative estimate, however. Most engineers are quite aware that even when the capacity is exceeded, the barrage can still be operated within a certain safety envelope. The question then becomes which region—upstream or downstream—has the more powerful political representation. Upstream residents typically want the breaching section operated quickly to relieve water pressure on their land. Downstream communities, to save their land, either want to delay its operation or for it to not be breached at all. Such political negotiation is well known at the local level and has caused considerable alienation among the populace, who perceive their lands as being inundated because they lacked the political capital to save them. This alienation is further accentuated when relief is inadequate or is provided by actors who may have more belligerent agendas.

For example, unsubstantiated claims have asserted that the 2010 floods considerably compromised the legitimacy of the Pakistani government because of its fumbling response to the crises. Its inadequacies allowed the humanitarian wings of some Islamic militant organizations to insert themselves into the relief effort and, subsequently, gain greater legitimacy in the eyes of flood victims. Preliminary testimonies suggest that these groups used their involvement to win recruits for their causes:

> I am not so sure if these jihadist elements like Lashkar-e-Tayyaba have any long-term impact on the social landscape in the flood affected areas as a result of their relief efforts. They have a single agenda item—to recruit people for Jihad. They show up in the aftermath of floods, provide relief, try and win recruits, and, in my experience, move on, only to reappear in the next flood.[73]

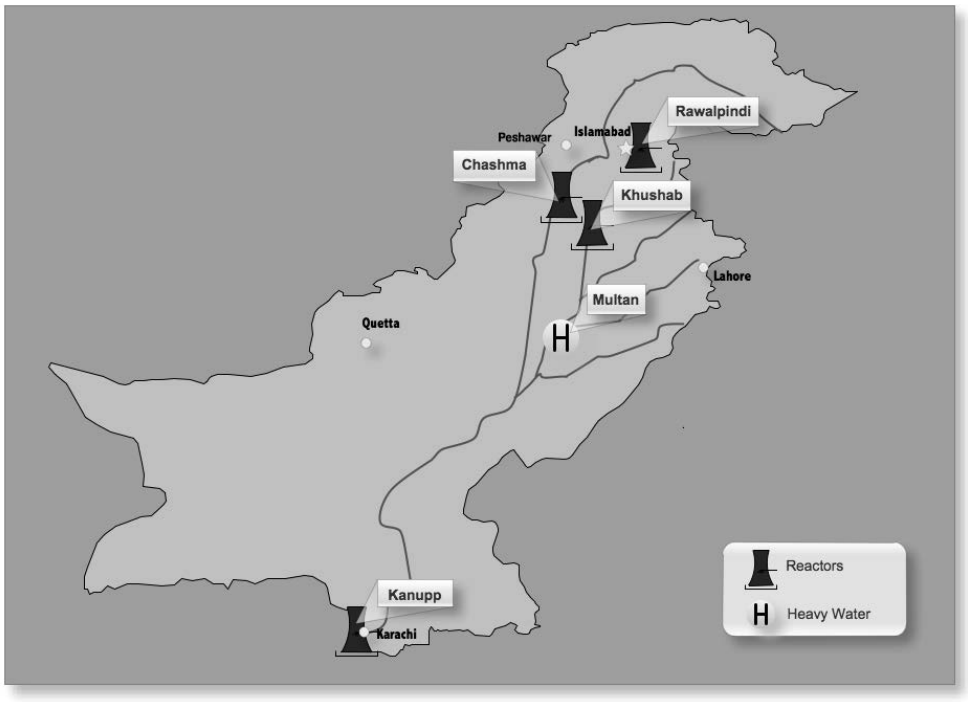
Systematic research on the linkages between inequity in access to irrigation and increased vulnerability to flood hazards on the rural poor and penetration of extremist ideologies amongst the young people in the rural area could help elucidate the linkages between local level irrigation and flood management and security.

The drought in the late 1990s and early 2000 in southern Pakistan was also a preview of the types of challenges that climate change may present in a more accentuated form. The period saw massive rural to urban migration: In some cases, entire communities were dislocated and abandoned. Inappropriate responses to the drought in the form of greater tubewell penetration in Balochistan had the type of consequences discussed. The ongoing Baloch insurgency that began in the mid-2000s coincided with the drought and was driven by many political factors. A detailed examination of the linkages between the drought, social dislocation, and alienation of the Baloch—and to a lesser extent Pashtun youth in the province—would be useful in understanding the types of security challenges that can emerge from such hazards.

The drought and flood hazards, along with less dramatic shifts in planting seasons and penetration of new disease vectors in Pakistan, will require the type of responsive and flexible governance institutions that do not exist—at least not at the government level. The disconnect between the increasing expectations of a more politically aware population and the inability of the state institutions to respond to those challenges is likely to result in security challenges related to civil strife and delegitimization of the state that demand immediate attention.

Most alarmingly, many of Pakistan's nuclear reactors are on the banks of the Indus along the Chashma Barrage (see map 2). A nuclear accident at that location could conceivably contaminate a sizeable portion of the country's food supply. Details of the installations are not publicly available, and any studies on such a scenario are unknown. Given the importance of the river to the country's agriculture, however, investigating such a scenario in greater detail is warranted.

Map 2. Location of Pakistan's Major Nuclear Facilities



Challenges to Effective Water Management

Effective water management requires a strategy that integrates institutions, policies, skills, and technology to foster conservation, efficiency, productivity, and disaster relief. A collaborative approach that embraces all stakeholders is needed to ensure that altering water supplies will meet future requirements. Thus far, Pakistan's water stress has been explained in terms of supply and demand, but the crisis haunting the state is rooted in unsustainable practices and gross mismanagement. Unless serious changes are made to address these institutional inefficiencies, governance weaknesses, and political deadlock, Pakistan may witness upsurges in resource-based violent conflict. Yet successful reforms could be the key to more harmonious interactions.

Pakistan's water stress has been explained in terms of supply and demand, but the crisis haunting the state is rooted in unsustainable practices and gross mismanagement.

Governance

Pakistan's governance patterns may be one of the biggest factors preventing effective water management. Its regulatory and institutional deficiencies are increasing tensions among stakeholders, who are failing to communicate and cooperate with each other to overcome the weak policies and enforcement mechanisms of the water sector. Most alarming is a seemingly general apathy toward changing current policies and practices.

Water disputes in Pakistan are chronic. The perennial irrigation water shortages create conflict between provinces, with each accusing the other of bad faith and duplicity. The lack of water laws that define water rights often pit users against each other; land ownership rather than water use serves as a proxy for water rights.[74] Water bureaucracy in Pakistan is also notoriously corrupt due to both the ineffective internal administrative checks on decisions made by irrigation bureaucrats and the pressure for these bureaucrats to accommodate large landowners, who are often politicians.[75] A reported 25 percent of farmers have acknowledged paying

bribes to irrigation officials for water.[76] These officials have almost total discretion in deciding water entitlements. Fighting this corruption is often futile, because Pakistan's legal system is slow and no actual system for enforcing rights is in place.

Pakistan has a multiplicity of water-related legislation and regulations, dating back to colonial rule, as evident in table 3. This list does not even touch on the numerous land and tenancy laws that define water rights and usage based on land ownership. The most important legislation governing water in the country is the Canal and Drainage Act 1873, which provides the key legal framework for water management in the agricultural sector. The act allocates considerable administrative and judicial authority to irrigation department officials with almost no provision for public accountability.[77] It mandates a fixed time rotational irrigation schedule. It is well known that temporally equal water rights at the head and tail reaches of watercourses deliver much less water at the tail end. This geographical inequity, well known at the time of the framing of the act, is not accounted for in the legislation and hence legitimizes structural inequities in the irrigation system.[78] Furthermore, the act provides for collective punishment for possible individual acts of sabotage of irrigation infrastructure, giving absolute administrative and judicial authority to irrigation department functionaries to adjudicate disputes.

Furthermore, the act recognizes all water resources as government property and specifically links water rights to the land. Water rights cannot be legally traded independently of the land. However, in reality, vibrant and active water markets do exist independent of land. The inflexibility inherent in the *warabandi*[79] (fixed time rotational irrigation scheduling) system means that farmers have to take water when it is their turn, regardless of whether they need it or how much of it they need. From the beginning, Pakistani farmers have actively traded water rights for reciprocal times or cash payments. The act criminalizes this pervasive and somewhat efficient practice.

The *abiana* (water tax) mandated in the act, and paid for by the farmers, kept the irrigation system profitable until the early 1970s, when the populist government of Zulfikar Ali Bhutto froze the abiana. Today, the abiana remains at the same level, resulting in provincial irrigation and drainage authorities (PIDA) incurring massive losses that fail to provide adequate resources for the effective operations and management of the system. Donors have pressured the government to increase the abiana receipts and to decentralize the system from a bureaucratic system to a more cooperative farmer-run system, where the farmers are in charge of water allocation and revenue collection. The Provincial Irrigation and Drainage Act (1997) responded to this donor pressure to turn provincial irrigation departments from government agencies to regulatory authorities. In the future, these authorities would regulate farmer-run area water boards along canal commands and farmer organizations along village water courses while withdrawing from the day-to-day management of the system. In practice, governance methods have not really changed.

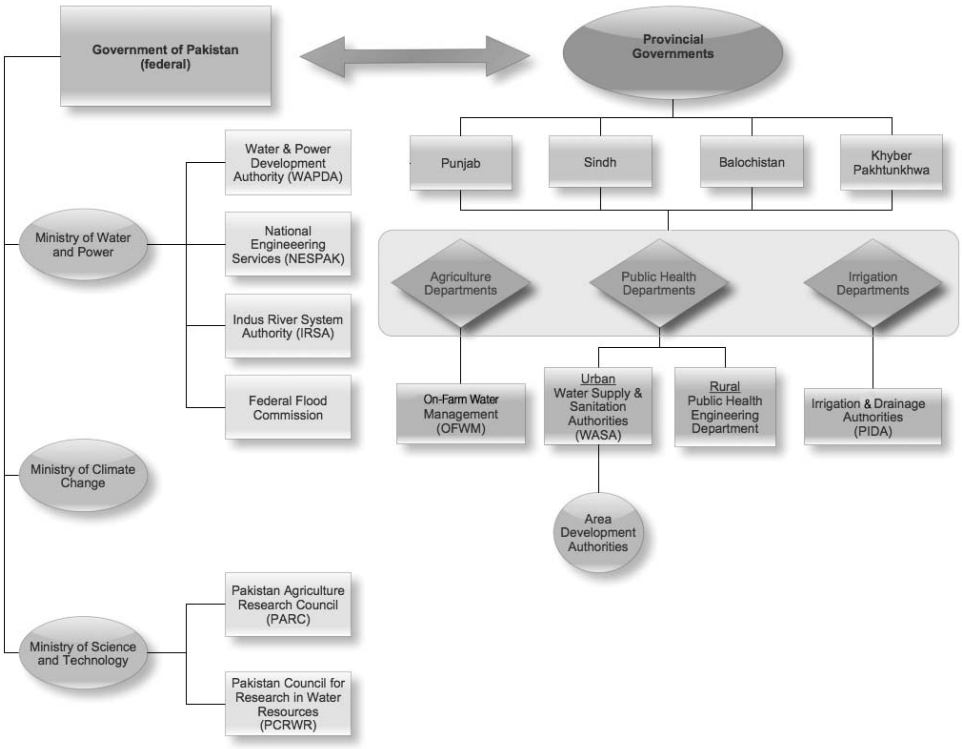
In the province of Balochistan, given its high dependence on groundwater, the importance of ongoing groundwater mining was recognized. The Balochistan Groundwater Rights Administration Ordinance of 1978 outlined a procedure for licensing tubewell development in the province in an attempt to tackle groundwater mining. The licensing of tubewells was supposed to be based on area-specific guidelines to be sanctioned by area water boards, but the guidelines were never formulated. In some instances, communities mobilized to institute self-regulating groundwater management in some districts, but in the aftermath of the drought in the 1990s, many of those systems came to naught. Some are in place in the southwest of the

Table 3. Key Water-Related Legislation in Pakistan

Date	Legislation	Implementation	Key Feature
1860	Pakistan Penal Code	federal	Penalizes water pollution as a public health issue
1873	Canal and Drainage Act	federal and provincial	Governs irrigation water use
1882	Easement Act	federal	Grants and limits rights for water pollution
1883	Land Improvement Loans Act	provincial	Provides loans for water distribution, drainage, and reclamation
1905	Punjab Minor Canals Act	provincial	Governs irrigation water use
1927	Forests Act	federal and provincial	Governs disposal of waste and effluent
1934	Factories Act	federal	Penalizes pollution of water in forests
1949	Karachi Joint Water Board Ordinance	municipal	Prohibits pollution of water supply; first water law at municipal level
1952	Punjab Development of Damaged Areas Act	provincial	Allows government to construct sewage and drainage in "damaged areas"
1958	West Pakistan Water and Power Development Authority Act	provincial and federal	Establishes what is today the Water and Power Development Authority
1960	Indus Waters Treaty	international	Governs sharing of Indus River waters between Pakistan and India
1976	Territorial Waters and Maritime Zones Act	federal, international	Declares maritime territory and boundaries
1980	Sindh Fisheries Ordinance	provincial	Prohibits dumping of pollutants in water
1981	On-Farm Water Management and Water Users' Association Ordinance	federal	Provides resources for improved irrigation water management
1991	Indus River System Accord	provincial	Governs water sharing between provinces
1997	Provincial Irrigation and Drainage Authority Acts	provincial	Implements irrigation reforms
1997	Environmental Protection Act	federal	Governs protection, conservation, rehabilitation, pollution, and improvement of environment
2009	National Drinking Water Policy	federal	Provides institutional framework and guidelines for provinces to assure quality and supply of drinking water
2010	18th Amendment to the Constitution of Pakistan	federal	Devolves Ministry of Environment to provinces, establishes forums for interprovincial dialogue
2011	Punjab Environmental Protection (Amendment) Bill	provincial	Establishes Punjab Ministry of Environment

Source: Jawad Hassan, *Environmental Laws of Pakistan* (Lahore: Book Biz, 2006)

Figure 4. Water-Related Institutions in Pakistan



province where a predominance of traditional karez-based systems remain. In the rest of the province, conflict continues between tubewell adopters and the karez shareholders, the latter typically fighting a rearguard battle against the adopters.

The structure of institutions governing water and development at the federal, provincial, and local levels are quite complex and disconnected, muddling accountability and data sources. In 2009, the passage of the 18th Amendment devolved seventeen federal ministries to the provincial level. Now water management at the federal level lies mostly within the jurisdiction of the Ministry of Water and Power. In addition, each province has its own authorities that govern irrigation, water development, and supply and sanitation. Data on water use are circulated every ten days, from the Indus River System Authority (IRSA) to the provincial irrigation departments to the watercourses in the fields then back to the central offices and IRSA. As discussed later, how these data are collected and shared is a source of mistrust and controversy between the provinces. An overview of the formal water governance structure is presented in figure 4.

Data on water use are circulated every ten days… How these data are collected and shared is a source of mistrust and controversy between the provinces.

In water supply and sanitation, as well as in industrial water use, the most well-endowed and influential institutions are typically the area development authorities, because they are the primary conduits through which provincial governments channel their resources. Questions about the disconnect between their remit and power and their lack of accountability, however, are constant. Service delivery is both unreliable and corrupt. Local governments' ability to raise funds and sustain the Water Supply and Sanitation Authorities is also questioned. PIDAs, however, continue to be at the bottom of the pecking order in the water sector, partly because of the low political influence of rural areas. Institutional reform would help reverse

the weak governance that is fueling socioeconomic discontent and eroding citizens' confidence in their government and rule of law. The major obstacle will be garnering the political will to reform these traditional power structures.

Policy Approach

In addition to its institutional and regulatory shortcomings, Pakistan's policy approach, which is oriented in supply-side interventions, is also lacking. The overall ethos of the water institutions favors engineering megaprojects, and this bias continues to be reflected in the government's main policy documents, as well as in the present project portfolio by donors and institutions in the country. This approach only veils the problem of water use inefficiencies.

The storage capacity of the Indus basin irrigation system, which commands thirty-four million acres for irrigation, is only about 121 MAF per capita per year, or a thirty-day supply. Existing dams are rapidly silting, with Mangla and Tarbela losing about 25 percent capacity since they were commissioned in 1967 and 1976. Furthermore, water losses from within watercourses and between canal heads and watercourses amount to about one-third of the total amount of delivered water; an additional 25 percent is lost within farms.[80] Poor management and distribution of irrigated water translate to only 45 percent of cultivable land being farmed at any given time. In other words, Pakistan currently uses 97 percent of its allocated water resources to support one of the lowest productivities in the world per unit of water.[81] Although dams contributed to turning arid land green and offered productive benefits at the outset, the water realities of today render their current use unsustainable. By treating water as a raw material, technical solutions are deployed to harness the water's fullest capacity, which ignore the shortfalls and constraints in water supply and funds for operation, maintenance, and investments.[82] Simply repairing and maintaining Pakistan's existing canal systems could free an estimated 76 MAF of water.[83]

Poor management and distribution of irrigated water translate to only 45 percent of cultivable land being farmed at any given time.

Focus on supply-side intervention comes with fiscal stress. Pakistan has been unsuccessful at making irrigation users pay for water or the operation, maintenance, and manpower costs of water infrastructure. So after donors foot the bill to build large storage projects, virtually no one supports their operation and maintenance, rendering the neglected projects almost useless in resolving the country's water problems.

Over the past decade, Islamabad adopted a number of policies and strategies to address the country's various water challenges. These include the Drinking Water and Sanitation Policy (2009), the National Climate Change Policy (2011) and the Environment Policy (2005), which includes a supplemental Water Supply and Management Policy. In particular, the 2003 Pakistan Water Strategy has become the focus of domestic and international debate about water management. This comprehensive strategy outlines the blueprint for water resources in the country for the first quarter of the twenty-first century. The question remains how these documents will be translated into action by the responsible institutions, which remain megaproject oriented. Earlier water sector investment plans[84] made similar claims about integrated water resource management only to continue to focus on its megaproject supply-side interventions in the water sector. The prognosis for the present water strategy is the same in the absence of real institutional reform in the water sector.

Moreover, a comprehensive National Water Policy was drafted in 2005 but has yet to be adopted. Debate has been intense over the policy's approach in addressing water scarcity, demand, and population pressures and whether the policy should focus more on storage projects

or conservation and efficiency strategies. The draft policy is marred by provincial disputes over water rights and priorities, demonstrating yet another obstacle to effective water management.

Intersectoral Competition

As the debate over water policy continues, the opportunities for developing additional water resources or maintaining water use at existing levels are diminishing, and intersectoral demand for additional water is rapidly increasing. Current management strategies are further polarizing society, posing threats of greater instability across society and water sectors. The challenge thus becomes developing an integrated water management and use strategy, water-efficient techniques, and containment of environmental degradation across all water sectors.

Much of the forecasting on water availability and requirements focuses on agriculture and what the country will need to feed the growing population. But this increase in population also means changes in water use for urbanization, industrialization, agricultural diversification, and environmental needs, which will inevitably increase competition. Water quality is becoming just as much of an issue as water quantity. The urban and industrial sectors face several development challenges. These sectors need to raise the level of service quality and reliability in water supply in large metropolitan areas and industrial states. Access to a piped water supply in small towns and rural areas should be extended. Sources of sanitary and industrial effluents need to be blocked before entering fresh water ways. Development should not come at the cost of contaminating already limited water sources. Finally, as Pakistan develops, balancing shifts in supply and demand will become a major challenge, as a growing middle class demands more water-intensive convenience technologies and higher commodities, such as meat, dairy, and more diversified produce. With the right incentives, one can choose less water-intensive industries just as one can choose less water-intensive crops.

Supply-side water policies and the concentration on large-scale infrastructure projects to balance water availability—notably dams—often ignore these socioeconomic realities in addition to minimizing the consequences of flooding, population displacement, and lost livelihoods. This displacement often hits poorer communities, who may have no other safety nets and may be more vulnerable to violence and extremism. In addition, migration is adding pressure to urban water supply and sanitation. The extent of the problem requires further investigation.

Skills and Technology

Room for improving water efficiency through technological interventions in the agricultural and domestic water supply and sanitation sector is considerable. Faith in technological solutions, however, must be tempered with an understanding of the environmental and social contexts within which technologies may or may not have their full potential impacts.

At the macro-basin scale of interprovincial water distribution and flood warning, Pakistan generally depends on manual gauge readers. The volumetric calculations for water flow are based on empirically calibrated equations. In interprovincial water disputes, Sindh frequently accuses Punjab of misreporting data. Furthermore, accusations have been made that those who operate gauge readers make up readings for absentee days or make up entire arrays of readings. Evidence also indicates that gauges cannot be accessed during high floods or become invisible because of high siltation and water levels in the channel. To improve data quality and to reduce suspicions between provinces, the government installed a telemetric system on the

Indus River system, which, according to press reports, is not functioning.[85] Accusations have also been made that the Punjab government or some functionaries in the Punjab Irrigation and Drainage Authority are deliberately sabotaging the system to appropriate extra water for the province or to hide preferential illegal water diversions to more influential water users. When one of the authors of this report asked about these accusations, a senior official said that the telemetry system was not as accurate as the manual system. The telemetry system is a simple and old technology used worldwide. The claim that human readings are more accurate is not credible. The problem may be the incentive structures of the institutions that militate against the use of technology.

Considerable attention has been given to dam construction for surface storage in the water bureaucracy, which in the Pakistani context is probably one of the most inefficient types of storage solutions in a hot, dry country because of evaporation losses. Little attention has been paid to groundwater storage through injection wells or otherwise, which could be much more efficient. Often, energy generation benefits are pointed out as an additional benefit of surface storage. Energy generation benefits are undeniable, but greater attention to groundwater storage in addition to surface storage could help water managers expand their range of options in the face of greater demands on water and uncertainty in the face of climate change.

Energy generation benefits are undeniable, but greater attention to groundwater storage in addition to surface storage could help water managers expand their range of options.

At the microscale, laser land leveling has often been touted as an effective way of improving water's productive efficiency. The leveling makes a constant slope of a field, thereby ensuring that during flood irrigation, gravity controls the flow of water and evenly irrigates the entire field. The benefits of the technology, as might be expected, have largely been directed toward larger farmers. The technology has also been criticized for compromising the soil ecology by killing many beneficial soil organisms, which contribute to soil productivity.

Sprinkler and drip irrigation has also been proposed as a substitute for flood irrigation to conserve water. Although the principle is obvious given the high silt content of Pakistani rivers, the two technologies are not suitable for use with surface water. They could, however, be usefully deployed in conjunction with groundwater. But even there, the capital expenditure combined with the operation and maintenance costs mean that only relatively prosperous farmers who can afford the expenses of the technology can benefit from them. The social implications of the technologies aside, farmers often prefer the silt-laden surface water for its soil rejuvenating qualities. A case can also be made for flood irrigation in the sense that it does recharge the aquifer, which is particularly useful near urban areas, being that most of urban water supply in Pakistan is from groundwater.[86] Drip irrigation and sprinkler irrigation is, however, finding greater success in Balochistan, where most of the irrigation is from groundwater and a higher proportion of agricultural land is covered with orchards and trees, which are more suitable for drip irrigation.[87]

In terms of water supply and sanitation, the situation in Pakistan remains dismal. More than 40 percent of the population do not have access to clean drinking water—90 percent in rural areas.[88] The water supply and sanitation systems remain on the old networked water systems for which Islamabad does not have the capital or human resources to maintain or enough water to maintain perpetual water pressure so as to avoid sewage contamination. Appropriate technologies promoting modular systems in urban and rural water supply as well as for sanitation could go a long way toward addressing the ongoing, and rather silent, public health crises. Nevertheless, behavioral change in water usage will prove key to ensuring lasting efficiency.

Addressing Perceptions

A number of field studies and interviews were conducted to gauge a provisional level of understanding of Pakistan's water and security issues at official and grassroots levels.[89] The statements here reflect these findings.

The water and security nexus in Pakistan is complex because water is such a dominant part of the economy and the society. The country's water and security concerns are widely known, but it is the perceptions of water and security among stakeholders and decision makers that prevent viable solutions for effective water resource management. Three general perceptions have been observed. First, Pakistan's decision makers and those in power are not directly affected by water insecurities and have little incentive to change the system or make water management reform a priority. Second, the people who work in the water sector generally have engineering backgrounds and tend to focus on supply-side solutions, disregarding the changing dynamics of water demand, society, and the environment. Finally, deep mistrust and perpetual disputes prevent provincial leaders from working together to find constructive ways to address Pakistan's water problems. These initial conclusions are anecdotal and require more extensive surveying to be truly representative.

In addition, three disparate views of the water and security nexus across sectors and populations in Pakistan exist. The first is on the issue of policy. For water managers, particularly civil engineers, and the federal government, the solution to shortfalls in water supply compared to demand is more storage. Forecasts of water scarcity and energy shortfalls are resulting in urgent pushes for the country to build more dams.

> In Pakistan, water and security linkage is likely to be experienced via the energy sector. If we do not build more dams to address the energy supply situation in the country and continue to have the type of electricity load shedding that we are experiencing right now, there is likely to be a lot of civil unrest. . . . thermal and private power generation is too expensive and beyond the reach of the common person. Only the construction of more dams which generate cheap electricity with solve the problem.[90]

In addition, leaders of each province are suspicious of each other's claims of the extent of their water insecurity. Disagreement is also strong between provincial leaders, namely Punjab and Sindh, and between the federal government and the provinces. Punjab's water managers, for example, often portray themselves as victims of political machinations and foreign NGO influences, whose suggestions translate to the disadvantage of Punjab:

> In Punjab, water demand is much greater, but there are fewer water projects compared to demand that have to work with lower water allocations. For example, in the 1992 inter-provincial water accord, Punjab's water demand and use was much higher compared to the allocation, and that allocation was even less than water the existing infrastructure in Punjab could deliver. . . . Sindh's ecological argument is not valid—agriculture must take precedence over ecology. . . . politicization of this argument between Sindh and Punjab is causing mistrust between the two, and foreign-supported NGOs are the main culprits for this state of affairs.[91]

This statement illustrates the conflation of Punjab and Pakistan interests, the dismissal of oppositional concerns as irrational or undesirably "political," the implied equivalence of "politics" with "nuisance," and the reliance on international expertise to bolster claims are all dominant perceptions that shape the public discourse on water politics and policy.

Thus, the political geography of center-province tension is crucial to understanding subnational water politics.

> [Kalabagh Dam] is for the benefit of the whole country and not for any particular province or region. It has been found feasible by the world's leading experts and approved by the World Bank for financing. Despite the need for its earliest construction, it has been held hostage in a political quagmire.[92]

The Sindhis, on the other hand, express apprehension toward Punjabi claims about Kalabagh dam being a national interest:

> In Sindh, there are apprehensions not just about Punjab's intentions right now as a federating unit, but also in terms of the fragility of the Pakistani state. What if the worst fears are realized? Would Sindh want to hand over control to Punjab of a most critical resource for its survival? Kalabagh is being bandied about in terms of its benefits for power generation, but our fear is about the water diversions and canals they are going to be build on the right and left banks of the river with the Kalabagh project to irrigate districts in Punjab and KPK. In Sindh, we have accepted Bashar Dam in Kohistan because it is a purely power generation project with no possible water diversions—we can live with that.[93]

Pakistani water managers at the federal level tend to dismiss provincial apprehensions regarding construction of more dams and see it as unnecessary politicization of an essentially technical debate with national interest at stake, which must not be held hostage to regionalist parochial interests. In fact, Punjab's irrigation managers even allege that Sindh is misrepresenting water data to cover the "wastage" of water that goes into the sea:

> Water escaping downstream of Kotri (the last diversion structure on the Indus before the Arabian Sea) is going to waste. Sindh has been reporting less water escaping downstream of Kotri than we thought. My staff assessed the escapage [sic] at 15000 cusecs downstream of Kotri while Sindh was reporting it at 5000 cusecs. [In response to probing] Sindh habitually misreports water flows while we in Punjab definitely do not.[94]

These dominant perceptions of water management at the policy level are manifested in increasingly rigid provincial identities and the unstable capacity and integrity of the Pakistani state.

A second divergent view of the water and security nexus concerns water usage. The politics of region give way to the politics of production and property as the scale of analysis shifts to the local level and focuses on issues of agricultural water management and irrigation reform. One leading water expert within civil society stated that the competition over water between agricultural (rural) and domestic (urban) use is already creating tension. For example, water is often cut off in the big cities, particularly Karachi, triggering protests on an almost daily basis. Landowners often "steal" this water for agricultural use:

> Land rights are a proxy to water rights . . . whenever the government invests in infrastructure, land value goes up. [Since] landowners sit in Parliament, they do not want any law that compromises their benefits . . . [Pakistan's] culture, politics, and economics render a lot of power in a few hands.[95]

Such disproportionate allocations of power breed insecurity. Civil society leaders emphasize Islamabad's ability to "learn to cope with water scarcity," just not at the Indus's current levels. The country's current culture of rent-seeking behavior has proved unproductive, yet there is "very little political will to change things."[96] What is missing is the investment in an infrastructure that could store and recycle floodwaters, which can compensate for years of drought and lessen the competition between water users. It should also be a priority to set water prices that represent its socioeconomic value, similar to how gas is priced.[97]

In Sindh, and certainly among environmental activists, focus on the health of the Indus delta and how that might affect the livelihoods of the indigenous communities is considerable. The progressive civil society actors also tend to be attentive to microscale inequities inherent

in the irrigation system and stress the need to address those before large-scale storage projects are undertaken.[98]

> In these modern times people are abandoning the ancient and traditional irrigation, and trying to maximize cropped area. Ever since the tubewells have arrived, a competitive trend has emerged amongst the people and farmers. The installation of tubewells for modern irrigation succeeded in increasing agricultural productivity, but it also gravely damaged the ancient *karez* system. *Karezes* were a great source of social and communal life for us village folks. People would sit on their sides and discuss their issues and find solutions to their problems.[99]

The third perspective of the water and security nexus concerns how informed and engaged the various stakeholders and policymakers are with each other. Finger-pointing over the country's water problems is considerable, as evident in the almost daily protests. However, solutions are superficial, and cooperation often lacking.

The more progressive civil society actors tend to view the water and security nexus from an institutionalist lens, stressing the need to address water resources as a politico-technical issue where technological interventions should be filtered through the political lens to take all of the stakeholders along. Sympathy is considerable for the reservations of smaller provinces regarding construction of big reservoirs on the Indus and operations of link canals in Punjab and even for a nascent concern in Punjab about the diminishing regard for rivers as a cultural heritage.

> In the middle Indus (southern Punjab) the water issue is less politicized. But starting in [the] 1990s, even in Punjab, the local communities have been resisting mega water development projects, starting with the construction of the Chasma irrigation project in 1990s. We are slowly moving away from a heroic colonial perspective on water.[100]

Some show a reflexive understanding about the intermingling of region, water, and identity.

> Water matters more to you depending on where you are. Village people are more sensitive to water issues than city people. . . . Debate on water shortages is much more important if you are in Sindh. They always feel that water shortages are because of Punjab. The level of awareness, of even kids and common people on the street, is therefore more advanced.[101]

As for the general public, the perceptions on water typically follow the ethnic divide. The Punjabi populace are typically more enamored of the official government narrative about water scarcity as underpinning the water and security nexus. In rural Punjab, however, appreciation of the institutionally driven inequity in water access as underpinning the water and security nexus is greater.[102] In the smaller provinces, sympathy for the progressive civil society's perspective on water and security is decidedly greater.[103]

In addition, the public generally takes water for granted, which is why costs are often provided below economic value.

> The common perception says that you shouldn't have to pay for water. Water should be free. It is God's gift to mankind.[104]

If the current path of water management continues, Pakistan may see the angry protests and isolated acts of violence turn into a larger, more organized form of conflict.

If the current path of water management continues, Pakistan may see the angry protests and isolated acts of violence turn into a larger, more organized form of conflict. Policy is not the only challenge. Citizen education is needed to overcome the public's apathy toward water security. But citizen education requires support from the government in terms of legislation, conservation strategies, and law enforcement. Currently, government interest at this level is nonexistent, because the government tends to view only "big" projects as "real" projects.[105]

The facts of water supply and the security situation are not news to the country's politicians and water stakeholders. Yet there seems to be a major disconnect on what the various actors see as the most contentious issues and how water problems should be solved. The result is a deep mistrust among stakeholders and decision makers, partly explaining the stalemate in passing

meaningful water policies and strategies. The lack of consensus on water sector priorities not only creates a vacuum for improved resource management but also leaves the security around water that much more volatile. Thus it is crucial to correct these misperceptions if there is to be any significant shift in water policy and management. Water stakeholders and policymakers would be better served using their collective skills, knowledge, and expertise to develop an effective strategy that tackles Pakistan's precarious water environment and offsets any violence over water resources.

Filling the Gaps

Water is not a driver for insecurity but a contributing factor to overall instability. Water is a hot spot because the scarcity and quality threaten the livelihoods of the Pakistani people. Violence associated with water derives from the frustrations and grievances with mismanagement and poor governance. It becomes important, then, to address the nuances of the structural obstacles of distribution inequalities and general water shortages to tackle insecurity from the ground up.

Conflicts over water use often go full circle. Rural residents migrate to cities to escape either violence or lost livelihoods (notably agriculture), only to strain the urban water supply system that competes with agricultural water use. In addition, agricultural shortages cause increases in food prices, which adversely affect the urban poor who might have come from rural communities.[106] The competition not only becomes an issue of inequality but also of imbalances. Also, linkages between sectoral water pressures should be further analyzed collectively. Solutions will require an integrated approach to supply and demand management.

Pakistan will have to develop the institutional mechanisms to deliver services to its burgeoning urban populations. Here there is a need to study the poor's access to domestic water and find avenues for formalizing and legitimizing those avenues. In the long term, conservation is key. Both surface and groundwater resources are being used at capacity, and current methods of extraction and uses are not only unsustainable but also damaging to the economy and human security. Future food security depends on changes in agricultural production. It is unsustainable to grow high water-consuming crops, such as sugarcane, in a semiarid country. It is more economical to import these commodities from water-rich countries and switch to farming crops that use local water resources more efficiently and can bring better, more reliable financial returns.

Debates surrounding the building of dams should also be scrutinized. The concentration on dams as the only solution to water and energy supply grossly ignores the need for resource behavioral change and the role of other energy sources, including renewable and alternative. Understanding the life cycle of water use for major production processes and products can help explain the efficiency problems and guide policy formation.

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Finally, greater experimentation with water pricing systems is needed. Pricing of water will not work by taking a one-size-fits-all model formulated by international development organizations. Rather, any sort of devolution of water allocation mechanisms, whether through market pricing or other means, must take the highly unequal agrarian property relations in Pakistan as its starting point.[107] Given the fact that landed Pakistanis have long taken advantage of "free" water, public outreach campaigns will be crucial for transforming perceptions. Integrated water management will also require more domestic resources to repair and maintain infrastructure and invest in innovative technologies. In Pakistan, this translates to tax reform. The country's tax rate is less than 9 percent of the value of its economy, and less than 1 percent of the population pays income tax, making it one of the lowest effective tax rates in the

world.[108] Effective management can only come from domestic reform, and dependence on foreign aid will not render lasting solutions.

This study is by no means a complete analysis of the security challenges facing Pakistan's water sector. Its goal is to demonstrate how policymakers and water stakeholders seem to underestimate the extent of the potential threats to water and its economic future. More data and analysis are needed to understand the extent of each of these challenges and subsequent security threats to pinpoint potential hot spots. In particular, effective policies require greater supply and demand linkages, as opposed to the field's supply-oriented literature. This report also presents some areas where tensions are strong, but whether they have the potential to become violent needs more research. A better understanding of the water-security nexus will allow for more effective programming that empowers and engages water stakeholders from the official to the grassroots level. The future of Pakistan's water sector does not have to be ominous. There are great opportunities to address these challenges and avert violent conflict. Ultimately, change starts with political will.

Better understanding of the water-security nexus will allow for more effective programming that empowers and engages water stakeholders from the official to the grassroots level.

Recommendations

Engage public, private, and civil sectors in the development of a comprehensive national water policy. Such alliances can better meet the various aspects of Pakistan's water security challenges and help ensure a shared policy framework that includes mitigation, adaptation, and equitable distribution strategies. Given the realities of water supply, a national policy should emphasize both demand management and conservation to ease competition over water between users and sectors. Elements should include better crop patterns, disaster risk management, and strategies for changing water use behavior at all levels. The involvement of community, regional, and academic leaders can establish broad-based support for effective policy framework and initiatives.

Devise a strategy for improved service provision and strengthen enforcement mechanisms for water use. Such a strategy would first require a comprehensive understanding of sector demands and the life cycle of water availability and use. Interventions would need to balance water requirements in relation to energy and food security, and appropriate regulations should ensure reliable and affordable service provisions. Stronger mechanisms of enforcement are needed to limit pollution, secure tariff collections, and ensure efficient and equitable use of surface and groundwater.

Improve communication and data sharing mechanisms. Given that mistrust runs so deep and many decision makers are the ones benefiting from the status quo, more efforts should be made to ensure transparency and accountability at all levels of the water sector. Donors and civil society can both work to ensure appropriate checks and balances of reported water data and of decisions made by water managers and irrigation officials. Transparency can be achieved by using up-to-date technology and enacting stronger legislation that requires more oversight of water usage.

Promote the adoption of innovative business models and methods of water conservation. Such strategies would help ease microlevel tensions and conflicts surrounding water by addressing resource challenges through new technologies, investments, and efficiency gains. Conservation strategies could include rainwater harvesting, water recycling, and drip irrigation.

Strengthen disaster risk management strategies at the local level. This is a bottom-up approach for addressing the impacts of environmental hazards, including dispossession and

migration. By doing so, Pakistan can ensure effective and timely relief and recovery through local institutions and help increase the legitimacy of formal governance structures.

Conclusion

The competition over water and the effects of environmental hazards in Pakistan provoke political instability when other problems and grievances already exist. In essence, water insecurity can make a bad situation worse. One way to ease the tension is to address water management in an altered environment. Solving the water scarcity problems should come from doing more with less. Doing nothing is not an option. As shortages become more widespread, it is crucial that the government invest greater political capital to regulate water competition and provide quality water services to all communities. Pakistan does not have the capacity to find new sources of water or to inject more water into its national grid. Delaying efforts to address its water insecurities will only intensify, perhaps even violently, the various disputes between water stakeholders. Civil unrest, economic vulnerabilities, and political fragility already plague the country. Water stress should not be the security tipping point but rather a path to social harmony, environmental sustainability, and national unity.

Water sector priorities should address economic efficiency, environmental sustainability, and equity, which should be included in a framework to reorient water demand and improve water management. Regulating and altering water use behavior could curtail water shortages, and Pakistan could pave the way for more economic development, which could help lower poverty rates and ease tensions between water users. It will be a long incremental process, but one that needs to be initiated earnestly through appropriate institutional reforms in the water sector and a healthy dose of democracy in the water resources decision-making structures. The statistics, technology, and consequences of no change are known, but anticipating the conflict ramifications of water insecurity in Pakistan requires further analytical work.

Notes

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By 2030, experts expect Pakistan, a semiarid nation whose economy is still based primarily on agriculture, to decline from being water stressed to water scarce. The competition over water and the effects of environmental hazards in the country provoke political instability when other problems and grievances already exist. In essence, water insecurity can make a bad situation worse. Doing nothing is not an option, yet Pakistan does not have the capacity to find new sources of water or to inject more water into its national grid. Delaying efforts to address the situation will only intensify disputes between water stakeholders. Civil unrest, economic vulnerabilities, and political fragility already plague the country. Water stress should not be the tipping point but instead a means to promote social harmony, environmental sustainability, and national unity. This report provides a preliminary analysis of water management within this critical national context.

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