112TH CONGRESS
1st Session

COMMITTEE PRINT

S. PRT.
112–10

AVOIDING WATER WARS: WATER SCARCITY AND CENTRAL ASIA'S GROWING IMPORTANCE FOR STABILITY IN AFGHANISTAN AND PAKISTAN

A MAJORITY STAFF REPORT

PREPARED FOR THE USE OF THE

COMMITTEE ON FOREIGN RELATIONS
UNITED STATES SENATE

ONE HUNDRED TWELFTH CONGRESS
FIRST SESSION

FEBRUARY 22, 2011

Printed for the use of the Committee on Foreign Relations

Available via World Wide Web: http://www.fdsys.gpo.gov

U.S. GOVERNMENT PRINTING OFFICE
64–141 PDF WASHINGTON : 2011

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
Fax: (202) 512–2104 Mail: Stop IDCC, Washington, DC 20402–0001

COMMITTEE ON FOREIGN RELATIONS

JOHN F. KERRY, Massachusetts, *Chairman*

BARBARA BOXER, California	RICHARD G. LUGAR, Indiana
ROBERT MENENDEZ, New Jersey	BOB CORKER, Tennessee
BENJAMIN L. CARDIN, Maryland	JAMES E. RISCH, Idaho
ROBERT P. CASEY, JR., Pennsylvania	MARCO RUBIO, Florida
JIM WEBB, Virginia	JAMES M. INHOFE, Oklahoma
JEANNE SHAHEEN, New Hampshire	JIM DEMINT, South Carolina
CHRISTOPHER A. COONS, Delaware	JOHNNY ISAKSON, Georgia
RICHARD J. DURBIN, Illinois	JOHN BARRASSO, Wyoming
TOM UDALL, New Mexico	MIKE LEE, Utah

FRANK G. LOWENSTEIN, *Staff Director*
KENNETH A. MYERS, JR., *Republican Staff Director*

CONTENTS

LETTER OF TRANSMITTAL

UNITED STATES SENATE,
COMMITTEE ON FOREIGN RELATIONS,
Washington, DC, February 22, 2011.

DEAR COLLEAGUES: This report by the committee majority staff examines United States policy with respect to water scarcity and water management in Central and South Asia. Water plays an increasingly important role in our diplomatic and national security interests in the region, and we must ensure that our approach is carefully considered and coordinated across the interagency. President Obama's administration deserves credit for recognizing the critical role water plays in achieving our foreign policy objectives. As water demand for food production and electricity generation increases, in part as a result of the quickening pace of climate change, so too must our efforts to provide water security. While much of our focus currently rests on Afghanistan and Pakistan, we must also consider the interests in the shared waters by India and the neighboring five Central Asian countries—Uzbekistan, Tajikistan, Kazakhstan, Kyrgyzstan, and Turkmenistan. This report draws on staff travel to the region and the work of experts in government, academia, and international institutions. It provides significant insight and several key recommendations to advance U.S. policy in Central and South Asia with respect to this vital transboundary resource.

Sincerely,

JOHN F. KERRY,
Chairman.

AVOIDING WATER WARS: WATER SCARCITY AND CENTRAL ASIA'S GROWING IMPORTANCE FOR STABILITY IN AFGHANISTAN AND PAKISTAN

EXECUTIVE SUMMARY

Water scarcity is often overlooked, underfunded, and undervalued within foreign policy. Yet a government's ability to provide and manage access to water is critical for ensuring political, economic, and social stability.

In Central and South Asia, particularly in Afghanistan and Pakistan, the impacts of water scarcity are fueling dangerous tensions that will have repercussions for regional stability and U.S. foreign policy objectives. The national security implications of this looming water shortage—directly caused or aggravated by agriculture demands, hydroelectric power generation, and climate instability—will be felt all over the world.

To its credit, the Obama administration has recognized the critical role water plays in achieving our foreign policy goals and in protecting our national security interests. For the first time, the United States has elevated water-related issues in its bilateral relationships with priority countries, such as Afghanistan and Pakistan. Accordingly, the U.S. strategy and foreign assistance budgets now include significant investments allocated toward activities that promote water security through high-visibility projects, such as expanding water storage capabilities and irrigation.

However, the U.S. approach walks a fine line with respect to water issues and must be tailored to reflect the realities of water politics in Central and South Asia. While the focus of the United States is appropriately directed toward Afghanistan and Pakistan, it is important to recognize that our water-related activities in the region are almost exclusively confined within the borders of these two countries. We pay too little attention to the waters shared by their Indian and Central Asian neighbors—Uzbekistan, Tajikistan, Kazakhstan, Kyrgyzstan, and Turkmenistan. For example, in 2009 the United States provided approximately $46.8 million in assistance for water-related activities to Afghanistan and Pakistan compared with $3.7 million shared among all five Central Asian countries for these efforts.

Providing the right support can have a tremendous stabilizing influence, but providing the wrong support can spell disaster by agitating neighboring countries. By neglecting the interconnectivity of water issues between Central and South Asia, the U.S. approach could exacerbate regional tensions. Our activities should be carefully calibrated to address a broad range of needs and encourage reluctant state actors to come to the negotiating table. The United

States must be cautious and recognize that, while regional stability will not be determined solely by our efforts to support water cooperation, regional stability can be strongly undermined by misguided support.

The United States has a historic opportunity to address these issues properly and intelligently. Congress has authorized $1.5 billion annually in foreign assistance to Pakistan, through the *Enhanced Partnership with Pakistan Act of 2009,* better known as the Kerry-Lugar-Berman bill. The Obama administration still faces critical decisions on how it will spend these resources. This report will detail several aspects of a coordinated regional strategy for allocating those resources.

This report analyzes how the United States can be more strategic in delivering water-related assistance in Central and South Asia to maximize its peacekeeping and humanitarian benefits. It also makes the following four recommendations to the administration with respect to water issues in the region that capture opportunities for enhanced cooperation and coordination:

1. Provide Benchmark Data to Improve Water Management

The countries in Central and South Asia, regardless of their level of development, lack publicly available access to consistent and comparable data on water supply, flow, and usage. This creates tension over the management of water by both upstream and downstream countries. Providing basic technical information to all countries is a constructive way for the United States to help create a foundation for bona fide discussion and debate over water management. The United States should support data-related activities specific to measuring and monitoring water flow and volume for key rivers and river basins. We should also promote technical partnerships in the region to monitor glaciers, track shifts in monsoons, and model climatic changes across a range of water flow scenarios.

2. Focus on Water Demand Management

The United States can help create space for regional and bilateral negotiations on water by reducing pressure on shared water resources. Countries in the region cannot simply engineer their way out of growing water scarcity; they must begin by improving management of their existing supply. In fact, many experts agree that these countries must start shifting their focus from increasing the supply of water to decreasing their demand for it. The United States should couple its support for activities that reduce demand for water with those that increase water use efficiency. Specifically, the United States can utilize its expertise in demand management and help countries reduce the amount of water consumed by the agriculture sector and regulate groundwater withdrawals.

3. Recognize International Dimensions of Water Issues and Deliver Holistic Solutions

The impact of the United States approach to address water in Afghanistan and Pakistan can extend far beyond each country's border, as water ignores political boundaries. Moreover, regional water management can be an important type of conflict management. U.S. assistance should encompass comprehensive activities, such as

strengthening river basin dialogues and establishing community-level water management projects on shared watersheds.

4. Safeguard Institutions Against Shocks to Water Supply and Demand

Long-term stability requires strong institutions capable of responding to sudden shocks to critical natural resources, such as water. When weak institutions are confronted with natural disasters or human interventions that suddenly disrupt water flow, tensions can flare. With decades of experience on water sharing agreements, the United States is well-positioned to support programs that build the institutional capacity of government agencies and universities in areas such as international water law, dispute resolution, mediation, and arbitration. The United States should also invest in institutions that support developing transboundary water sharing agreements.

This report is organized into seven sections. Section 1 provides an overview of water management in Central and South Asia. Sections 2 and 3 discuss the demand for water from the agriculture and energy sectors. Section 4 describes climate change's effect on water and how this can exacerbate local and regional tensions. Section 5 highlights how, in the aggregate, the demand for a diminishing supply of water portends a significant threat to national security. Section 6 outlines the U.S. foreign policy approach to water in the region and Section 7 provides policy recommendations for improving water management in conjunction with promoting stability in the region.

SECTION 1: WATER MANAGEMENT IN CENTRAL AND SOUTH ASIA

Accessible Freshwater is Scarce and Must Be Well-Managed

Water is a fundamental human need; and yet, it is also one of the most overlooked aspects in our daily lives. Water is more than just what people drink or use to clean or create power; it is also embedded in our food and environment. As a result, global water use has been growing at a rate more than double that of the world population in the last century.

Even though the majority of our planet is water, most of it is too salty or deep to be reached. As little as 0.75 percent of the total water available on Earth is accessible fresh water. Given such constraints, the real threat to this limited resource is poor management.

Poor water management has rendered water unusable and subject to exploitation at a rate faster than it is replenished, directly contributing to the growing water scarcity crisis. In 2006, the United Nations reported that many of the world's water problems come not from the physical absence of freshwater, but from poor governance and lack of investment in basic activities like sewage treatment and water efficiency programs.

Effective water management is difficult because precious freshwater is often not controlled or undisputedly owned by any one nation. In fact, more than 260 major rivers basins are shared by two or more countries. Human dependency on these transboundary freshwater basins exacerbates this delicate balance; approximately

40 percent of the world's population relies on them. This report focuses on two such primary water basins: the Amu Darya and Indus.

Weakened Water Management Systems in Central Asia

There are two main rivers in Central Asia: the Amu Darya and the Syr Darya. The Amu Darya is the largest river with a basin shared by Afghanistan, Iran, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. The river is formed by the confluence of the Vakhsh and Pyanj rivers. The most important river, the Pyanj, begins near Pakistan's Northern Territories and forms the border between Afghanistan and Tajikistan (see Figure 1). There are also several rivers within northern Afghanistan contributing to the Amu Darya flow, mainly the Wakhan and Pamir rivers and, to a lesser extent, the Badakhshan, Kokcha, and Kunduz.

Figure 1: Map of Amu Darya and Syr Darya River Basins

Source: CRS produced using U.S. Department of State, International Land Boundaries,https://www.intelink.gov/basestate/landBHome.asp; U.S. Geological Survey, HydroSHEDS, http://hydrosheds.cr.usgs.gov; World Resources Institute, Watersheds of the World, http://earthtrends.wri.org/text/water-resources/maps.html; ESRI Data and Maps 9.3.1; DeLorme World Vector Data, 1:250,000; IHS World Data, December 2008.

Notes: Place names and boundary representation are not necessarily authoritative. River basin boundaries are approximate and adapted from WRI Watersheds of the World and USGS HydroSHEDS databases.

During the Soviet era, the central government in Moscow controlled the entire network of rivers shared among its republics through water-use quotas. This approach meant that the borders between the Central Asian republics had little, if any, effect on basin management. The Soviet system involved integrated water

policies where in the summer, the two upstream republics (present day Kyrgyzstan and Tajikistan) released water from their lakes to the downstream ones (present day Kazakhstan, Uzbekistan, and Turkmenistan) for irrigation and hydroelectric power generation. In return, during the winter when it was not practical to release water, the downstream republics provided those upstream with gas and coal to generate electricity.

The collapse of the Soviet Union drastically weakened water management in the region. The previous controls broke down and national self-interests took hold. The former Soviet republics began to function independently, seeking to increase national control over water often at the expense of their neighbors. As Kai Wegerich, an expert in water policy put it, "[w]hen administrational boundaries became national boundaries in 1991, the Central Asian states were left with inequitable water allocation limits and a high level of water provision structures interdependences." [1] Recognizing the destabilized system, all five Central Asian countries agreed to keep the water quotas from the Soviet era in place and signed the Almaty Agreement in 1992.

In addition, agreements reached over water allocations during the Soviet era largely ignored non-Soviet interests, especially those of Afghanistan, a weaker neighbor. As a significant outlier in the process of developing regional water sharing agreements, Afghanistan's interests in the waters of the Amu Darya basin have only recently gained prominence. This renewed focus on Afghanistan derives in part from international reinvestment in the country's agriculture sector following the ouster of the Taliban government. However, sparse water data, limited access to collect it, and combat conditions have rendered challenging discussions on water between Afghanistan and its neighbors. Looking ahead, experts question whether and how this region will incorporate growing water consumption and its implications for regional stability.

Decentralized Water Management in South Asia

The Indus River Basin hosts a major network of rivers flowing between India and Pakistan. It is comprised of six shared rivers: Indus, Jhelum, Chenab, Ravi, Beas, and Sutlej (see Figure 2). The Indus is one of the world's longest rivers (1,800 miles long), originating in the Tibetan Himalayas, flowing west through Kashmir, then through Pakistan until eventually reaching the Arabian Sea. The upper portion of the Indus is fed by snow and glacial meltwaters and converges in the Punjab region of Pakistan with the five other rivers in the system.

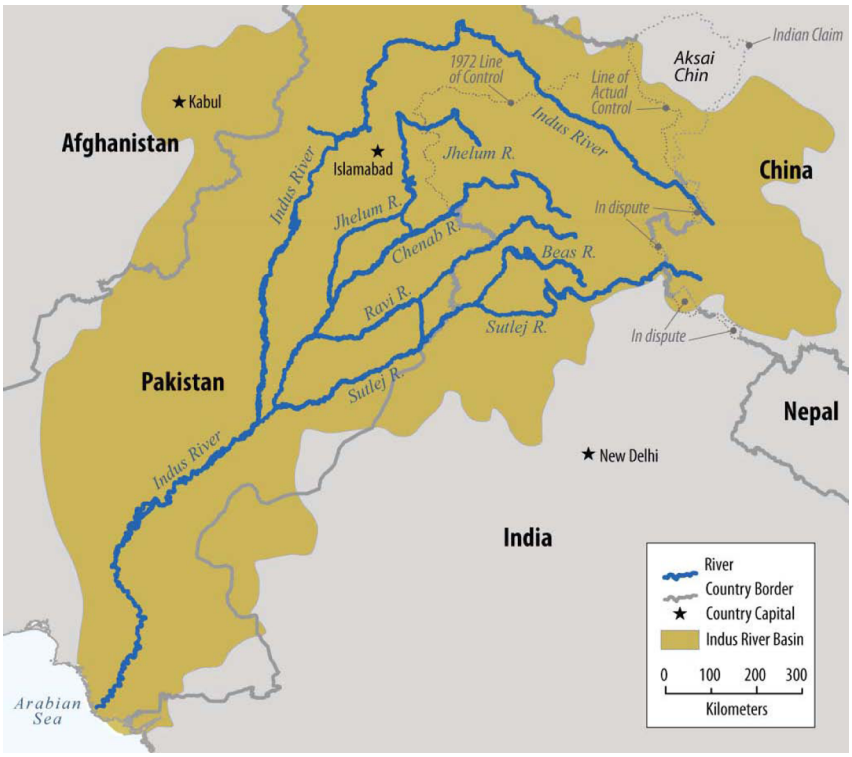

Figure 2: Map of Indus River Basin

Source: CRS produced using U.S. Department of State, International Land Boundaries, https://www.intelink.gov/basestate/landBHome.asp; U.S. Geological Survey, HydroSHEDS, http://hydrosheds.cr.usgs.gov;World Resources Institute, Watersheds of the World, http://earthtrends.wri.org/text/water-resources/maps.html; ESRI Data and Maps 9.3.1; DeLorme World Vector Data, 1:250,000; IHS World Data, December 2008.

Notes: Place names and boundary representation are not necessarily authoritative. River basin boundary is approximate and adapted from WRI Watersheds of the World and USGS HydroSHEDS databases.

Of all the rivers flowing into Pakistan, the Indus is the most essential because of its importance to the agricultural sector. Pakistan's agriculture relies on the world's largest contiguous irrigation system fed by the Indus waters; in fact, water withdrawals for agricultural irrigation represent almost 97 percent of all withdrawals in Pakistan. This irrigation network covers an estimated 83 percent of cultivated land in the country and contributes to nearly a quarter of its gross domestic product. Unfortunately, Pakistan has almost fully exploited the surface and groundwater that is crucial for its irrigation, so improvements in management and efficiency are vital.

Although the headwaters for the Indus originate in China, from a long-term planning perspective, it is India's water management of the Indus that merits scrutiny. With a population already exceeding 1.1 billion people and forecasts indicating continued growth to over 1.5 billion by 2035, India's demand for water is rising at

unprecedented rates. However, water management in India is extremely decentralized and virtually unregulated. Multiple government ministries have established water-use guidelines at the national level, but, they have little effect. Water management is constitutionally delegated to India's constituent states, which have limited capacity to coordinate among themselves. This has led rapidly to diminishing available surface and groundwater.

Waters flowing between India and Pakistan, unlike those in Central Asia, are managed within the framework of the Indus Waters Treaty (IWT), a long-standing agreement negotiated by the governments of India and Pakistan and the World Bank. Signed in 1960, the IWT is considered the world's most successful water treaty, having remained relatively intact for 50 years and having withstood four Indo-Pakistani wars.

The treaty gives control of the "western rivers" (Indus, Jelum, and Chenab) to Pakistan and gives India the "eastern rivers" (Sutlej, Beas, and Ravi) up to the Pakistani border. The treaty quantifies the amount of water both countries will receive from these rivers and serves an important function by managing the use of the rivers for hydroelectric power projects. It lays out guidelines for hydropower on the eastern rivers, allows Pakistan to object to projects, and specifies mechanisms for conflict resolution.

While the IWT has maintained stability in the region over water, experts question the treaty's long-term effectiveness in light of chronic tensions between India and Pakistan over the Kashmir region, where a significant portion of the Indus River's headwaters originate. In addition, others question whether the IWT can address India's growing use of the shared waters and Pakistan's increasing demand for these waters for agricultural purposes.

SECTION 2: AGRICULTURE AS A DRIVER OF WATER DEMAND AND TENSIONS IN REGION

Globally, the agriculture sector is the single largest consumer of freshwater, accounting for about 70 percent of the total volume of freshwater withdrawals from lakes, rivers, and aquifers. As a primary driver of water scarcity and source of tension within and among countries, agriculture policies produce water insecurity when they promote water-intensive crops and require unsustainable irrigation.

Agriculture is one of the chief factors that exacerbate water-related tensions in Central and South Asia.

First, local government policies continue to pursue cotton production in Central Asia, particularly in Tajikistan and Uzbekistan, adding further stress to limited water resources and driving water scarcity. The demise of the Aral Sea in Central Asia remains one of the most iconic global images of mismanaged agriculture policies and highlights the interconnectivity between such policies and water scarcity. The Aral Sea was once the world's fourth largest lake. It has shrunk by 90 percent since the rivers that fed the sea were diverted for Soviet projects aimed at boosting cotton production, a water-intensive crop.

Second, the loss of production and farm-level knowledge is exacerbating water scarcity. After the collapse of the Soviet Union, large collective farms became individualized. This meant that many

peasant farmers, who only had a single task to perform as part of the larger farming process, quickly became responsible for the entire production chain. These farmers lacked knowledge in maximizing productivity, so yields declined, irrigation canals became silted, and inefficiencies in water use increased.

Finally, government policies, including U.S. policies, have increased agricultural productivity by expanding irrigated land area without regard for the down-river impacts of those policies. For example, Afghanistan's 2007 Water Sector Strategy focuses on improving, rehabilitating, and reestablishing irrigated areas. In addition, the United States is investing in increasing Afghanistan's agricultural productivity by rehabilitating and constructing irrigation systems and providing seeds. However, little is known about the impacts that expanded irrigation could have on already sensitive rivers, such as the Amu Darya, which flows into Central Asia from Afghanistan. Without investments in managing the demand for water from irrigation, this solution can create conflicts among its users.

Similarly, proposals to expand irrigated land in India and Pakistan have exacerbated tensions between these neighbors. Water mismanagement and increased inefficiencies in the existing irrigation systems, requiring more water for less agricultural returns, compound the problem. As the existing agriculture system becomes more water-intensive and, in some areas, more inefficient, water may prove to be a source of instability in South Asia.

SECTION 3: GROWING CONCERN OVER USING WATER TO CREATE ENERGY

A second driver of growing frictions in the region is hydropower development. Lacking a coordinated management system, each nation is trying to meet its own energy needs without consideration of its neighbors. As many experts note, "transboundary water conflicts arise not over natural supplies but over human interventions to manage them. Dams, irrigation diversions, and other infrastructure alter hydrological relations, affecting the quantity, quality, and timing of downriver flows, but also relations between upstream and downstream riparians."[2]

As of late 2010, three dam projects are under consideration or construction in Kyrgyzstan (Kambaratinsk Dam) and Tajikistan (Rogun Dam, Sangtuda I and II Dam). The energy produced from hydroelectric power constitutes 27 percent of the total energy in Central Asia and is expected to grow to 3.5 percent if the proposed projects are built. The Rogun and Kambaratinsk dams are the two largest dams under consideration and would serve to store water in large reservoirs and generate electricity by releasing this water.

The proposed Rogun Dam on the Vakhsh River in southern Tajikistan is relevant because of its potential effects on energy security for Tajikistan and on water availability for Uzbekistan. This dam was first proposed in 1959 and construction began in 1976. However, the project stalled after the collapse of the Soviet Union. In recent years, the Tajik Government restarted the construction process. If completed, this dam would likely be the highest in the world and generate power not only for Tajikistan but enough to export to Afghanistan and Pakistan. These plans have raised serious

concerns across the border in Uzbekistan, as the Vakhsh River contributes approximately 25 percent of the water flows in the Amu Darya. In discussions with staff, Uzbek officials argue that because it could take up to 18 years to fill, the Rogun project will severely reduce the amount of water flowing into Uzbekistan.

The drive to meet energy demand through hydropower development is also occurring in India and Pakistan, two countries that lack sufficient access to energy. This is particularly true with respect to India, which faces a rapidly expanding population, growing economy, and soaring energy needs. To meet growing demand and cope with increasing electricity shortages, the government has developed plans to expand power generation through the construction of multipurpose dams. India has 33 projects at various stages of completion on the rivers that affect this region.

The number of dams under construction and their management is a source of significant bilateral tension. Currently, the most controversial dam project is the proposed 330-megawatt dam on the Kishenganga River, a tributary of the Indus. While studies show that no single dam along the waters controlled by the Indus Waters Treaty will affect Pakistan's access to water, the cumulative effect of these projects could give India the ability to store enough water to limit the supply to Pakistan at crucial moments in the growing season. In the difficult 60-plus year bilateral relationship, water has not yet been used in this way. However, staff met with some experts that argue the treaty's long-term stability is threatened by a lack of trust between these two countries. Any perceived reduction in water flows magnifies this distrust, whether caused by India's activities in the Indus Basin or climate change.

SECTION 4: CLIMATE CHANGE EXACERBATES WATER SCARCITY

As demand for water from agriculture and hydroelectric power generation grows in Central and South Asia, climate change is expected to increase water scarcity. Current Intergovernmental Panel on Climate Change (IPCC) projections of rising temperatures and sea levels and increased intensity of droughts and storms suggest that substantial displacements will take place within the next 30–50 years, particularly in coastal zones. As our planet's climate becomes increasingly unstable, our relationship with water is changing in dangerous and potentially catastrophic ways (see Figure 3).

Warmer temperatures threaten the cyclical changes to glaciers that provide essential water to the rivers in Central and South Asia. Glacier melt water is estimated to comprise 30 percent or more of the Indus River's flow, with snow and ice providing up to two-thirds more. In Central Asia, a report commissioned by the United Nations Development Program's Water Governance Facility noted that in the 20th century, the glaciers of Tajikistan decreased on average by 20–30 percent. In Afghanistan, this decrease is as much as 50–70 percent. While shrinking glaciers increase the run off in the short term, the long-term effect is a decrease in available water.

As the rate of melting increases, flooding could become more frequent and severe, particularly from "glacial lake outburst floods." These floods occur when runoff from glaciers builds up to form lakes that can burst and inundate neighboring regions. According

to a report by the United States Agency for International Development (USAID), *Changing Glaciers and Hydrology in Asia: Addressing Vulnerabilities to Glacier Melt Impacts,* there is "a history of outburst floods from Karakoram glaciers involving much larger impoundments by short-lived, unstable ice dams that blocked tributaries of the upper Indus . . . causing outburst floods of exceptional size and destructiveness." Changes in runoff to river basins can significantly exacerbate already tense relations over water-dependent sectors, such as agriculture and hydropower.

Finally, climate change is expected to influence monsoon dynamics that are vital for river systems dependent on their seasonal rains. The summer monsoon season is particularly crucial to the agriculture, water supply, economics, ecosystems, and human health of Bangladesh, India, Nepal, and Pakistan. A 2009 Purdue University study predicted an eastern shift in monsoon circulation caused by the changing climate, which today causes more rainfall over the Indian Ocean, Bangladesh, and Burma and less rainfall over India, Nepal, and Pakistan. This shift raises serious concerns for the countries expecting decreased rainfall. For example, summer monsoon rainfall provides 90 percent of India's total water supply. As the effects of climate change become more pronounced, agrarian populations in India and Pakistan dependent on monsoons and glacial melt for irrigation will be profoundly affected.

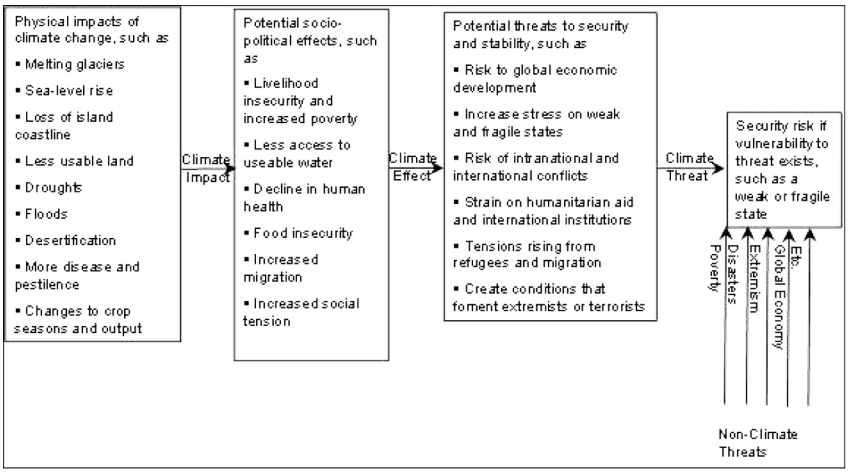

Figure 3. Illustrative Pathway of How Climate Change May Affect Security

Source: CRS

Notes: First two boxes were adapted from S. Smith and J. Vivekananda, A Climate of Conflict (International Alert, Nov. 2007), pp. 10-11, available at http://www.international-alert.org/pdf/A—Climate—Of—Conflict.pdf.

SECTION 5: CURRENT AND FUTURE WATER SCARCITY IS A NATIONAL SECURITY ISSUE

The national security implications of this looming water shortage—exacerbated and directly caused by agriculture demands, hydroelectric power generation, and climate instability—will be felt all over the world. The defense and intelligence specialists focused

on the region have recognized the threat of conflict stemming from ineffective water management within these countries. General Anthony Zinni (Ret.), former commander of U.S. Central Command, recently said, "[w]e have seen fuel wars; we're about to see water wars." It is imperative that the foreign policy community heed the warnings from top defense and intelligence experts. The United States should not only elevate water issues in foreign policy dialogues, but tackle them with a comprehensive approach.

The danger posed by water scarcity is that it triggers human insecurity, which can intensify potentially explosive tensions among neighboring countries or regions. As Dr. Peter H. Gleick, cofounder and president of the Pacific Institute for Studies in Development, Environment, and Security, wrote, "[w]here water is scarce, competition for limited supplies can lead nations to see access to water as a matter of national security. History is replete with examples of competition and disputes over shared fresh water resources."

As the defense and intelligence community increasingly acknowledge the links between natural resource degradation and national security, their views on the sources of future conflict are also evolving. The 2007 Center for Naval Analysis report, *National Security and the Threat of Climate Change,* found that "environmental crises such as water scarcity, soil depletion, and natural disasters can intensify conflict or stress within a country and potentially contribute to national security issues." When the Central Intelligence Agency inaugurated its Environmental Indications and Warnings program, whose mission is to "provide intelligence analysts with indications of where societies may experience environmental stress that exceeds local capacity to manage and adapt," the first environmental stressor they identified was freshwater availability. The Navigating Peace Initiative's Water Conflict and Cooperation Working Group correctly summarized the current state of water use by saying,

> . . . water use is shifting to less-traditional sources such as deep fossil aquifers and wastewater reclamation. Conflict, too, is becoming less traditional, driven increasingly by internal or local pressures or, more subtly, by poverty and instability. These changes suggest that tomorrow's water disputes may look very different from today's.[3]

Water conflicts can occur both within and across state lines. Since 1994, the Pacific Institute has maintained a Water Conflict Chronology summarizing historical disputes over water resources. The most recent update to this chronology was released in December 2009. It indicates that local and subnational conflicts are increasing in severity and intensity relative to international conflicts, noting that "[a] growing number of disputes over allocations of water across local borders, ethnic boundaries, or between economic groups have also led to conflict."[4] The National Intelligence Council echoed these concerns in their *Global Trends 2025: A Transformed World,* finding that with "water becoming more scarce in Asia and the Middle East, cooperation to manage changing water resources is likely to become more difficult within and between states."[5]

Given the important role water plays in Central and South Asia as a primary driver of human insecurity, it is important to recognize that for the most part, the looming threat of so-called "water wars" has not yet come to fruition. Instead, many regions threatened by water scarcity have avoided violent clashes through discussion, compromise, and agreements. This is because "[w]ater—being international, indispensable, and emotional—can serve as a cornerstone for confidence building and a potential entry point for peace."[6]

However, the United States cannot expect this region to continue to avoid "water wars" in perpetuity. In South Asia, the Indus Waters Treaty has been the primary vehicle for resolving conflicts over the shared waters between India and Pakistan. It is a prescriptive agreement that has recently been criticized for its inflexibility to adjust to changes in water levels. Experts are now questioning whether the IWT can adapt to these changes, especially when new demands for the use of the river flows from irrigation and hydroelectric power are fueling tensions between India and Pakistan. A breakdown in the treaty's utility in resolving water conflicts could have serious ramifications for regional stability.

SECTION 6: UNITED STATES FOREIGN POLICY ON WATER

U.S. Policies Beginning to Recognize Water's Strategic Importance

To its credit, the Obama administration has recognized the critical role water plays in achieving our foreign policy goals and in protecting our national security interests. The United States is now addressing water from a political, economic, and diplomatic perspective.

Politically, senior officials in the administration are integrating water considerations into our efforts overseas. U.S. embassies and missions have elevated the importance of water in our diplomacy and an interagency process has been established to coordinate and advance a U.S. policy on water. In a speech delivered on World Water Day 2010, Secretary of State Hillary Clinton laid out a new "five streams" approach to U.S. international water engagement.

"Five streams" refers to five different focus areas that together form a comprehensive strategy. The first stream is capacity-building at local, national, and regional levels. This effort seeks to empower key actors at all levels of water management, both nationally and internationally. The second focus is coordination between U.N. agencies, international financial institutions, government entities, and other stakeholders. The third element is financial support, whether from the United States through USAID, the World Bank, or other international institutions. Science and technology form the fourth stream. While it is important to remember that technology alone will not be able to solve the world's water problems, scientific advancements can make enormous differences in the developing world. The final input is private sector engagement. Public-private partnerships allow the United States to leverage private sector skills and capital to better respond to challenges in the water sector.

Economically, the portion of the U.S. foreign assistance budget dedicated to address water issues has slowly increased since 2005.

The budgets for high-priority countries, such as Afghanistan and Pakistan, now include significant funds for water-related assistance, receiving approximately $46.8 million in 2009. The majority of this is targeted at efforts in Pakistan, particularly in the aftermath of this summer's devastating floods.

Diplomatically, the United States has identified water as a central foreign policy concern with far-reaching effects. For example, the U.S. Government's 2010 Inter-Agency Water Strategy for Afghanistan is focused on improving access to safe drinking water and sanitation, agricultural irrigation, and water-sector management. A significant portion of U.S. assistance is aimed at rehabilitating the Kajaki dam to provide much needed electric power for the country and potentially for future irrigation purposes. Similarly, in November, President Obama and Prime Minister Singh agreed to work together on food security cooperation as part of the "Evergreen Revolution" where water figures in nearly all the components of this effort.

The United States also elevated water activities in Pakistan by launching a multiyear Signature Water Program and establishing a water working group within the U.S.-Pakistan Strategic Dialogue. The Signature Water Program aims to improve Pakistan's ability to manage its water resources and improve water distribution. The first phase of the program focuses on building high efficiency irrigation systems, water storage dams, municipal water and services delivery, and dams for irrigation. In the aftermath of the floods, these programs are still going forward but with adjustments to reflect new needs given that the floods destroyed 30 percent of arable land.

Need to Improve Integrating Water with U.S. National Security Interests

While the United States has appropriately begun to elevate its interest in supporting water through "signature" projects in these regions, our efforts still lack strategic clarity, unity of purpose, and a long-term vision to support our national security interests. The next section describes four recommendations focused on encouraging a U.S. foreign policy that strengthens our support in the region and promotes efforts to increase transboundary water cooperation and stability in Afghanistan and Pakistan.

SECTION 7: RECOMMENDATIONS FOR ACTION

1. Provide Benchmark Data to Improve Water Management

The countries in Central and South Asia, regardless of their level of development, lack publicly available access to consistent and comparable data on water supply, its flow, and use. This paucity of data causes friction over the management of water by upstream and downstream countries. Providing basic technical information to all countries is a constructive way to create a foundation for bona fide debate over water management. Specifically, the United States should build on its comparative advantages to support the following four data-related activities.

First, the United States should provide technical trainings on how to gather water flow and volume information using remote

sensing or other related technologies. Scientists in Central and South Asia can capitalize on the expertise of U.S. agencies, such as the United States Geologic Service, Environmental Protection Agency, and National Oceanic and Atmospheric Administration, to learn how to access and collect such data. This type of data-sharing is contemplated in the inaugural strategic dialogues launched this year with India and Pakistan, but for Central Asia more work is needed.

For example, the Amu Darya river basin countries do not know how much of the river's flow originates in Afghanistan. Similarly, little is known about aquifer recharge rates due to limited data on water quality and security issues with collecting on the ground data. The United States should support expert exchange programs with Central Asia, Afghanistan, and Pakistan. These programs should include support for the development of local and remote monitoring capacity through the use of new technologies, such as NASA's Gravity Recovery and Climate Experiment. With such assistance, the United States can provide the tools necessary to develop baseline data on water.

When staff traveled to Central Asia, they observed that key water-dependent neighbors, such as Tajikistan and Uzbekistan, lack a common baseline from which to begin discussions over water use. In both countries, government officials agreed that climate change and water use for energy or agriculture could have a significant effect on water supply, but they lacked sufficient resources to meet their research needs. In addition, tensions between these two countries continue to escalate as plans to build the Rogun Dam move forward without any common baseline for what the impacts of the dam are on water flow. Although the Tajik Government claims that the dam will have only a minimal impact on river flows into Uzbekistan, the Uzbek Government disagrees. According to the facts, as both countries see them, they each have compelling reasons to support or oppose this dam.

Second, the United States should support increased technical capacity to monitor changes to glaciers because these changes can significantly affect river flows and the livelihoods that depend on them. Central Asia and India face critical challenges in monitoring glaciers and tracking changes, particularly differences from year to year. As USAID's report *Changing Glaciers and Hydrology in Asia: Addressing Vulnerabilities to Glacier Melt Impacts* noted, "[t]he review of scientific information about glacier melt in High Asia revealed, first and foremost, a lack of data and information, a lack that hampers attempts to project likely impacts and take action to adapt to changed conditions."[7] The United States should engage in collaborative glacier monitoring programs and those that develop local or sub-national water monitoring capacity. In the case of Central Asia, the United States could support bringing back the expertise and data collection that fell into disrepair after the end of the Soviet era. For example, Tajikistan has lost almost 38 percent of its glacier monitoring stations since 1985.[8]

Third, the United States should support scientific studies to monitor, track, and analyze changes in monsoon rains that play an important role in food security. Studies on climate change have traditionally focused on temperature increases, sea-level rise, and

droughts; but for a region like South Asia, it is changes to the monsoons that will be felt the hardest. Early climatic trends show that monsoon rains will become more erratic and intense, leading to more flooding, less soil absorption, and lower agricultural productivity. The more we understand the changes to the monsoon, the better positioned we will be to partner in our efforts to promote sustainable agricultural programs. This type of collaboration has already begun with the recent signing of the "Monsoon Agreement" between the United States and India, which seeks to improve long-range monsoon prediction through collaboration between the National Oceanic and Atmospheric Association and India's Ministry of Earth Sciences.

Fourth, the United States should support efforts in Central and South Asia to model changes to water flow and volume for entire river basins across a range of scenarios, from the impacts of climate change to the construction of dams. Understanding these impacts, which generally take the form of reduced or irregular water flow, will help governments make more informed decisions on water management. Today, most of these basins only have studies on the outcomes of individual projects, rather than the cumulative impact of multiple projects. Without complete river basin analysis for the Amu Darya, Syr Darya, and Indus, countries in Central and South Asia are left to negotiate water allocations and usage based on either the status quo or their own assumptions, neither of which lends itself to finding synergies. The United States should support the development of basin-level water modeling and scenario analysis through technical exchanges and partnerships with Central Asian and Indian universities.

Basin-wide modeling is also useful for addressing tensions over hydroelectric dam proposals that continue to agitate countries sharing rivers. Dams are often the easiest target for public scrutiny, blame, and anger when water flow changes, regardless of whether they are the culprit. For the major dam proposals in the region, such as Rogun and Kishenganga, there is still no independent analysis of the cumulative impact these projects will have on water flow, especially during the low flow season. Providing water flow models for a range of construction scenarios to all interested countries can form the basis for discussions on the utility of these projects.

2. Focus on Water Demand Management

The United States can help create space for regional and bilateral negotiations on water by reducing the pressure on shared water resources. This means recognizing that countries in this region cannot simply engineer their way out of growing water scarcity, but should begin managing water resources more effectively. In fact, many experts agree that these countries must start shifting their focus from increasing the supply of water to decreasing the demand for it. Supporting improved demand management is at its core a type of conflict management. The two critical areas for U.S. engagement are in addressing the agriculture sector's demand for water and in establishing better groundwater management.

The agriculture sector is the primary user of water globally. Agriculture policies create water security issues when these policies

promote water-intensive crops, such as cotton and rice. The United States can encourage the shift away from water intensive farming that drives many of the countries in the region to exhaust their water supply by incorporating water-saving projects in its international agricultural activities.

For example, there are advancements taking place in developing integrated and environmentally sound alternative approaches to water-intensive crops, such as rice. While it is still being demonstrated on a small scale, the system of rice intensification (SRI) is a promising new model of agricultural production centered on four components: planting method, water (irrigation) management, soil fertility management, and pest/weed control. SRI introduces simple changes to specific practices, though the fundamental procedures of rice production remain the same as in conventional systems. Implementing SRI on a broad scale would result in considerable water savings. Water use in SRI is typically 25–50 percent lower than conventional paddy systems because fields are not flooded throughout the entire production cycle.

The United States should also continue to focus on activities that result in significant water savings, such as increasing the efficiency of irrigation systems in Central and South Asia. While it is important that the United States help ensure Pakistani farmers have the ability to replant after last year's devastating floods, the current spend plan for our assistance lacks a comprehensive solution to addressing agriculture needs and water demands. For example, the current spend plan for fiscal year 2010 includes providing seeds and fertilizer and supporting agricultural extension and cooperatives. However, we must also incorporate, in tandem, repairs and improvements to the irrigation systems, efforts to strengthen dykes and embankment protections, and water storage through the construction of small to mid-size water storage units and rainwater harvesting.

Staff recently met with representatives from nongovernmental organizations in arid regions in Tajikistan, such as the Konibodom District in Khujand, Tajikistan, a town near the border of Uzbekistan. Staff learned that after the collapse of the Soviet Union the water supply system fell into disrepair and the irrigation canals became heavily polluted. Nongovernmental groups are now working to rehabilitate the water distribution systems. Interestingly, because water remains a scarce resource, these groups are establishing water associations to manage and fund water use. For this district, once completed, the system will supply 50,000 villagers with 40–50 liters per person per day.

Second, the United States should focus on the sustainability of access to water, not just access. As we have learned from past efforts to address water crises, the solutions of today can create the problems of tomorrow. For instance, to address India's growing drought crisis, the international community in conjunction with the Indian Government has significantly increased the distribution of individual tube wells to access groundwater. As Steve Solomon notes, "in 1975, before groundwater pumping became significant, India had about 800,000 wells . . . only a quarter century later, the nation had an estimated 22 million wells . . . and continuing to increase phenomenally, by about 1 million a year."[9] At the same

time, the Indian Government provided electricity subsidies that allowed individuals to run these pumps for several hours a day. As a result of this unfettered and exploited access, India is now the world leader in groundwater withdrawals, pumping out roughly 230 cubic kilometers annually, more than a quarter of the world total.

Going forward, the United States should consider integrating management of groundwater withdrawals with our efforts to promote access to water. This integration can be done through demand driven solutions, such as installing water gauges, collecting groundwater use and recharge, promoting water reuse, improving efficiencies in water delivery, and trainings on how to budget water among users.

Moreover, the United States can share its domestic expertise in groundwater management, from monitoring to mapping groundwater resources. For example, the U.S. Geological Survey collects data on domestic groundwater, including the Ground Water Atlas of the United States, which gives a summary of each principal aquifer in each of the 50 States, Puerto Rico, and the U.S. Virgin Islands. Specifically for this region, the United States can follow the model set forth in the Transboundary Aquifer Assessment Act with Mexico, which authorizes the United States to cooperate with the Mexican Government and other organizations to conduct hydrogeologic studies and modeling of transboundary aquifers.

While the United States should continue to focus on improving the efficiencies of water delivery, we must also support the development of plans to ensure the long-term maintenance of these systems. If we fail to do so, we may find ourselves with a more formidable challenge in the years ahead caused by water shortages and its destabilizing derivative effects.

3. Recognize International Dimensions of Water Issues and Deliver Holistic Solutions

The impact of our actions to address water extends far beyond a country's border, as water transcends political boundaries. This means U.S. actions centered on only one part of a river can have unintended consequences either upstream or downstream. For example, water projects are a priority for U.S. assistance in Afghanistan and Pakistan. However, if our assistance is managed or implemented poorly, it may increase tensions over water in the greater region. Our assistance should target comprehensive activities, such as strengthening river basin dialogues and establishing community-level water management projects on shared watersheds.

U.S. investment in Afghanistan and Pakistan, which is twelve times greater than what is invested in Central Asia, could have significant unintended consequences. Although it is strategically important for the United States to keep a laser-like focus on Afghanistan and Pakistan, especially on high-visibility water projects that can reduce internal tensions, the United States should also consider activities that promote regional cooperation over these shared river systems. As noted in the United States Government Accountability Office's report on U.S. efforts to support the Afghan water sector (GAO–11–138), "[f]our of Afghanistan's five major river basins flow into the territory or boundary waters of five

of its six neighbors—Pakistan, Tajikistan, Uzbekistan, Turkmenistan, and Iran. The construction of large water storage or diversion facilities could affect these countries. The ability of the Government of Afghanistan to achieve sustainable and multipurpose use of its abundant water resources will depend on its capacity to engage in dialogue, negotiate, and establish relationships and agreements with its neighbors." The United States should evaluate how it distributes regional assistance and consider supporting transboundary capacity-building on water issues.

In Afghanistan, the United States should support mechanisms that integrate U.S. expertise on water management and resource allocation within the Afghan Government. This would enable Afghanistan's interests over shared waters to be represented at regional dialogues. It will also foster a process that engages Afghanistan and Pakistan on the management of the Kabul River Basin. This basin is important to both countries because it has the potential to provide vital hydroelectric power to energy-poor Afghanistan and predictable water flows to key agricultural areas in Pakistan. Limited technical capacity within the Afghan Government to negotiate transboundary agreements has meant that no such water and energy sharing arrangement exists. However, the United States is already on the right track to get these negotiations started.

For example, U.S. expertise was recently used to improve water management data for the Kabul Basin drawing on the United States Geographical Survey in collaboration with the Afghanistan Geological Survey and the Afghanistan Ministry of Energy and Water. This project, supported by the United States Agency for International Development, included results from a multidisciplinary water-resource assessment that analyzed how a growing population and the potential effects of climate change affect water.[10] In addition, the United States has supported ground water assessments and a hydropower feasibility study in the Kabul Basin. With this information, U.S. assistance plans for Afghanistan should lay out concrete options for supporting regional activities, including those that encourage collaboration among Afghanistan, Pakistan, and Central Asia.

The United States needs a concrete vision and plan to help the region tackle its water challenges. Through the U.S.-Pakistan Strategic Dialogue, Under Secretary of State for Democracy and Global Affairs Maria Otero has seized the initiative by cochairing a water working group to examine how to respond to Pakistan's needs and improve U.S. assistance. This working group should now consider beginning a process to engage across country borders and supports basin-wide efforts. For example, the United States could facilitate basin-wide scenario planning, modeling, regional technical workshops, or direct interventions on water around basin-specific dialogues.

To support confidence building in basin-wide planning, the United States should also look for opportunities that create transboundary cooperation on smaller rivers. Successful pilot efforts on these rivers can be scaled-up to encompass larger rivers and even basins. Specifically, the United States should support local, community-based cooperation over shared rivers and watersheds. Staff heard in meetings with nongovernmental organizations

in Central Asia and India that the closer the solution moves toward the community, the more sustainable the solution. By helping create local control over water, the United States will be supporting a trust-building conflict management tool that can pay dividends in future.

For example, the United States has successfully engaged with water user associations (WUAs). These community-driven water management organizations often negotiate water supply agreements between farmers and management administrations and resolve disputes in a transparent and democratic manner. While in Tajikistan, staff visited a water user association formed with support from USAID and learned that farms that had previously paid collective water fees during the Soviet-era were forced individually to attempt to fill their quota on independence. WUAs were created to bring all farmers together and reduce conflicts, while also increasing land productivity because everyone received reliable water access. This particular WUA collected fees and was responsible for maintaining, rehabilitating, and improving the irrigation system. The WUA also created a tractor rental program to help increase farmers yields, generating revenues for the association to rehabilitate additional canals. Although WUAs typically have been limited to domestic portions of rivers, it is worth considering piloting these cooperative arrangements on transboundary segments of rivers.

Another successful water management mechanism has been piloted in Andhra Pradesh, India. This area relies entirely on the monsoons to replenish its groundwater resources and the area's particular geological characteristics limit underground storage. Those factors force farmers to focus on demand rather than increased exploitation of the groundwater. To accomplish this task, they come together to monitor rainfall, calculate available water, and decide which crops should be planted. Those meetings culminate in a water budget that is displayed on a wall in the village and updated as new information becomes available. Participation is voluntary but nearly 1 million people in 650 villages have joined, resulting in widespread changes in the variety of local diets and a move toward organic fertilizer. In essence, the program turns the people most invested in local water management, literally and figuratively, into "barefoot hydrogeologists." [11]

4. Safeguard Institutions Against Shocks to Water Supply and Demand

Transboundary waters by their very definition require international cooperation to avoid conflict. The formation of international institutions is an important way to solidify countries' commitment to sharing rivers equitably and when needed, resolve disputes. Long-term stability requires strong institutions capable of adapting and responding to immediate shocks to critical natural resources, such as water. When weak institutions are confronted with natural disasters or human interventions that suddenly disrupt water flow, tensions can flare.

The United States can play an important role by building or strengthening institutions to facilitate multilateral discussions in regions experiencing water scarcity. As a first step, the United States should build on the water data called for in the first rec-

ommendation of this report and support regional institutions capable of bringing together key stakeholders to discuss water sharing. Shared access to accurate data is critical in creating a foundation for negotiations. Having water baselines can help these institutions integrate the necessary flexibility to adjust to changing water patterns from climate change, hydropower development, and other possible changes.

A small grant by the United States to the United Nations Regional Center for Preventative Diplomacy for Central Asia (UNRCCA) is a step in the right direction. In a meeting with UNRCCA representatives, staff learned that they are elevating water cooperation through seminars, which include representatives from the Afghan Government as observers. The success of this institution will turn on its ability to continue to bring together all the Central Asian countries, including Afghanistan.

The United States should also invest in local or regional institutions that can support the development of agreements or treaties to address water management. These institutions are critical for managing the problems that arise when a dam is proposed or unseasonably low levels of rainfall leave countries searching for someone to blame. Studies found that "[s]tatistically, the likelihood of conflictual interactions over water appears slightly higher in areas of high dam density. But this propensity disappears where institutional arrangements such as treaties or river commissions exist to mitigate those pressures."[12] Once formed, institutions remain in place after disputes are resolved and can transform into tools for cooperation that address the needs and concerns of all interested states.[13]

Specifically, if tensions between India and Pakistan related to the treaty continue to grow, the United States should back relevant supporting institutions that both countries believe can help mitigate conflicts. In conversations with staff, experts expressed concern that over time the volume of water managed by the IWT is likely to change due to unsustainable water withdrawals, increased population growth, and climate change. The Pakistan Government has already alleged misappropriation of water from the Indus by India, which the latter denies. India has not made data on water volume in the Indus widely available, impeding efforts to build trust. Efforts described in the previous recommendations, such as improving monitoring of the Indus basin, decreasing water demand through efficiencies, and creating flexibility to respond to changes in water volume, are possible ways forward to address these concerns. The continued peace, stability, and success of the IWT are in the national security interests of all stakeholders, including the United States.

Staff was pleased to learn that the United States has begun to support regional discussions. For example, staff learned that the International Fund for Saving the Aral Sea invited Afghanistan to participate in discussions as an observer, with the possibility of joining in the future. The United States has provided the International Fund for Saving the Aral Sea with a small grant to the support the institution's technical capacity as well as offering the expertise of the United States Geologic Services to its executive committee. Similarly, local groups informed staff that they are

working to establish an Amu Darya river basin dialogue that would include Afghanistan. It is precisely these types of inclusive, intraregion dialogues to which the United States should continue to offer our expertise or other resources.

Finally, the United States can build stronger institutions and lasting agreements by investing in the people who are, and will be, responsible for water management, including government officials, youth, and farmers. This is already being done through technical exchanges between the United States and Central and South Asia, but such activities should be expanded to require the development of tools needed to reach agreement on water sharing. For example, the future water managers in Central Asia could be taught international water law, dispute resolution, or mediation at local universities. Given U.S. expertise in these areas, the United States should work to develop more informed water managers, which in turn can lead to more sustainable water agreements.

CONCLUSION

Water scarcity, coupled with how governments address these challenges, can exacerbate conflict or promote cooperation. Although it is still too early to determine the impacts of our efforts in the broader region, now is the time to begin evaluating water-related trends.

The Obama administration should be commended for recognizing the importance of water issues in its unprecedented commitment of assistance to Afghanistan and Pakistan. For the first time, senior government officials are recognizing the critical role that sound water management must play in achieving our foreign policy goals and in protecting our national security. Providing the right support can have a tremendous stabilizing influence in the region.

The four recommendations laid out in this report focus on encouraging U.S. policies that promote efforts to increase transboundary cooperation and stability. These recommendations call for targeted assistance that addresses water concerns by considering a broader range of needs and diplomatic consequences. Water security is not unique to Afghanistan and Pakistan, but successes there could be replicated in other regions facing similar threats. The lessons learned in water management and development in Central and South Asia can help the United States contribute further to diminishing tensions in other volatile and vulnerable regions of the world.

NOTES

1. Kai Wegerich, "Hydro-hegemony in the Amu Darya Basin," Water Policy, Vol. 10 No. 2 (IWA Publishing, 2008), 71–88 at 71.
2. "Fresh Water Futures: Imagining Responses to Demand Growth, Climate Change, and the Politics of Water Resource Management by 2040," Conference Report prepared by The Stimson Center (May 2010) at 4.
3. Aaron T. Wolf, Annika Kramer, Alexander Carius, and Geoffrey D. Dabelko, "Water can be a pathway to peace, not war," Environmental Change and Security Program Special Report, Issue 13 (2008–2009), 66–70 at 70.
4. Heather Cooley, Juliet Christian-Smith, Peter H. Gleick, Lucy Allen, and Michael Cohen, "Understanding and Reducing the Risks of Climate Change for Transboundary Waters," Pacific Institute (December 2009) at 2.
5. National Intelligence Council, "Global Trends 2025: A Transformed World," (November 2008) at x.
6 Aaron T. Wolf, Annika Kramer, Alexander Carius, and Geoffrey D. Dabelko, "Water can be a pathway to peace, not war," Environmental Change and Security Program Special Report, Issue 13 (2008–2009), 66–70 at 70.
7. United States Agency for International Development, "Changing Glaciers and Hydrology in Asia: Addressing Vulnerabilities to Glacier Melt Impacts," (November 2010) at 5.
8. The World Bank and Global Facility for Disaster Reduction and Recovery, "Improving Weather, Climate and Hydrological Services Delivery in Central Asia (Kyrgyz Republic, Republic of Tajikistan and Turkenistan)," at 14, available at: http://www.gfdrr.org/gfdrr/sites/gfdrr.org/files/publication/GFDRR—ECA—Hydromet—Study.pdf.
9. Steve Solomon, "Water: The Epic Struggle for Wealth, Power, and Civilization," New York: Harper Collins, 2010 at 423.
10. Mack, T.J., Akbari, M.A., Ashoor, M.H., Chornack, M.P., Coplen, T.B., Emerson, D.G., Hubbard, B.E., Litke, D.W., Michel, R.L., Plummer, L.N., Rezai, M.T., Senay, G.B., Verdin, J.P., and Verstraeten, I.M., 2010, Conceptual model of water resources in the Kabul Basin, Afghanistan: U.S. Geological Survey Scientific Investigations Report 2009–5262, 240, also available at http://pubs.usgs.gov/sir/2009/5262.
11. "Making farmers matter: And monitor, budget, manage—and prosper," The Economist (22 May 2010), Special Section at 12.
12. "Fresh Water Futures: Imagining Responses to Demand Growth, Climate Change, and the Politics of Water Resource Management by 2040," Conference Report prepared by The Stimson Center (May 2010) at 17.
13. Jerome Delli Priscoli and Aaron T. Wolf, "Managing and Transforming Water Conflicts," International Hydrology Series, Cambridge: Cambridge University Press, 2009 at 119.

○