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WATER IS LIFE

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Gathering in celebration of new village water sources, Eritrea. Photo credit: USAID.

CHAPTER 1. HYDROPOLITICAL VULNERABILITY AND RESILIENCE: *SERIES INTRODUCTION*

Aaron T. Wolf

Water management is, by definition, conflict management. Postel (1999) describes the roots of the problem: Water, unlike other scarce, consumable resources, is used to fuel all facets of society, from biologies to economies to aesthetics and spiritual practice. Moreover, it fluctuates wildly in space and time, its management is usually fragmented, and it is often subject to vague, arcane, and/or contradictory legal principles. There is no such thing as managing water for a single purpose — all water management is multi-objective and based on navigating competing interests. Within a nation these interests include domestic users, agriculturalists, hydropower generators, recreators, and environmentalists — any two of which are regularly at odds — and the chances of finding mutually acceptable solutions drop exponentially as more stakeholders are involved. Add international boundaries, and the chances decrease exponentially yet again (Elhance 1999).

Surface and groundwater that cross international boundaries present increased challenges to regional stability because hydrologic needs can often be overwhelmed by political considerations. While the potential for paralyzing disputes is especially high in these basins, history shows that water can catalyze dialogue and cooperation, even between especially contentious riparians. There are 263 rivers around the world that cross the boundaries of two or more nations, and untold number of international groundwater aquifers. The catchment areas that contribute to these rivers comprise approximately 47% of the land surface of the earth, include 40% of the world's population, and contribute almost 80% of freshwater flow (Wolf et al. 1999).

Sixty-three of these international river basins are in Africa, and their basins comprise 64% of the continent's surface. Most of these rivers are shared by two to four countries, although some are shared by many more: Congo and Niger (11 countries), Nile (10), and Lake Chad (8).

Within each international basin, allocations from environmental, domestic, and economic users increase annually, while the amount of freshwater in the world remains roughly the same as it has been throughout history. Given the scope of the problems and the resources available to address them, avoiding water conflict is vital. Conflict is expensive, disruptive, and interferes with efforts to relieve human suffering, reduce environmental degradation, and achieve economic growth. Developing the capacity to monitor, predict, and preempt transboundary water conflicts, particularly in developing countries, is key to promoting human and environmental security in international river basins, regardless of the scale at which they occur.

1.1 HYDROPOLITICAL VULNERABILITY AND RESILIENCE

In general, concepts of “resilience” and “vulnerability” as related to water resources are often assessed within the framework of “sustainability” (Blaikie et al. 1994), and relate to the ability of bio-physical systems to adapt to change (e.g., Gunderson and Pritchard 2002). As the sustainability

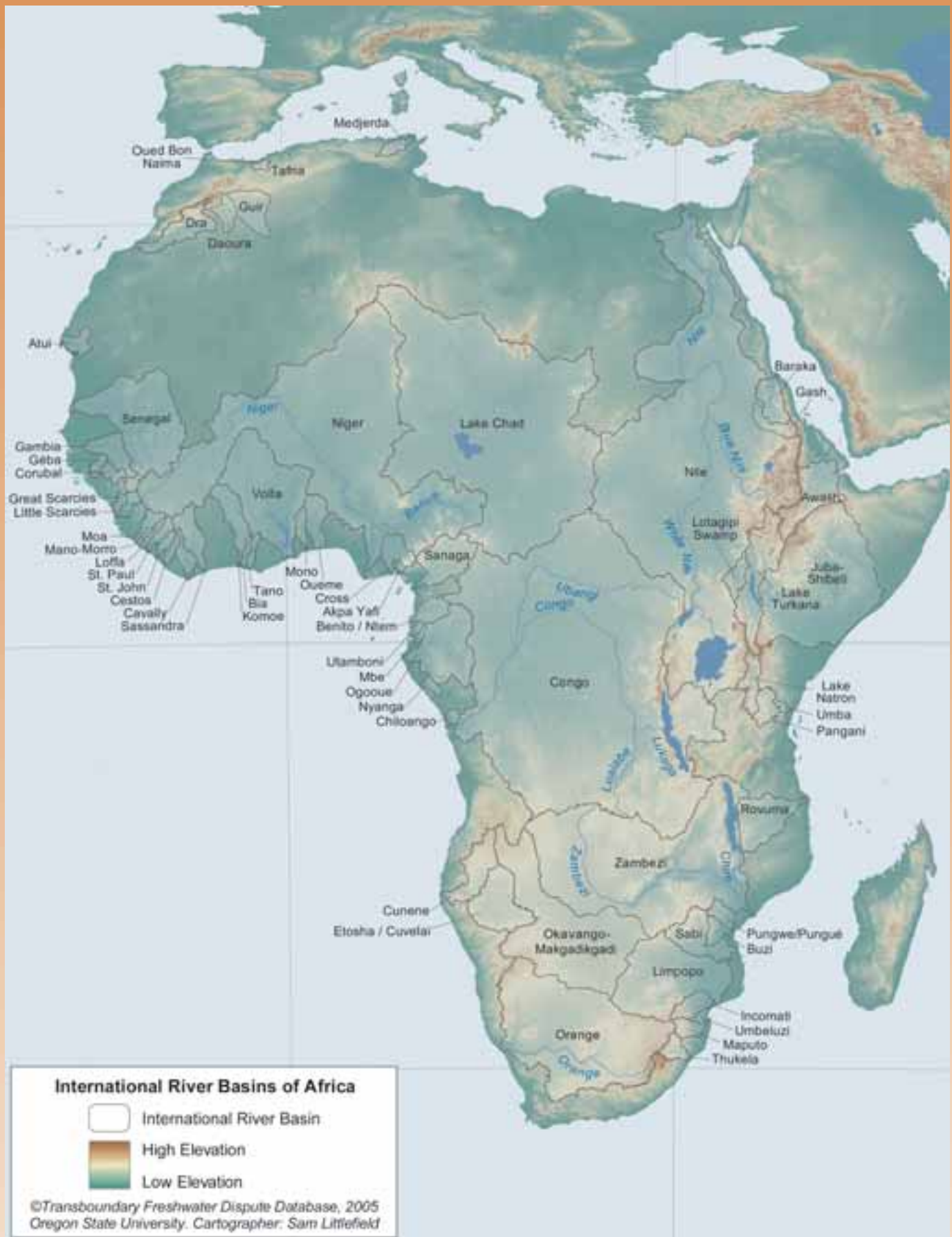


Figure 1.1 International river basins in Africa.



Figure 1.2 International river basins and countries, territories, and areas of Africa.



Angels' Flight over Victoria Falls, Zambezi River. Photo credit: Kenneth M. Gale, www.forestryimages.org.

discourse has broadened to include human systems in recent years, so too has work been increasingly geared towards identifying indicators of resilience and vulnerability within this broader context (e.g., Bolte et al. 2004; Lonergan et al. 2000; Turner 2003). In parallel, dialogue on “security” has migrated from traditional issues of war and peace toward also beginning to incorporate the human-environment relationship in the relatively new field of “environmental security” (see UNEP 2004; Vogel and O’Brien 2004).

The term “hydropolitics” (coined by Waterbury 1979) came about as the potential for conflict and violence to erupt over international waters began to receive substantial new attention. Hydropolitics relates to the ability of geopolitical institutions to manage shared water resources in a politically sustainable manner, i.e., without tensions or conflict between political entities. “Hydropolitical resilience,” then, is defined as the complex human-environmental system’s ability to adapt to permutations and change within these systems; “hydropolitical vulnerability” is defined by the risk of political dispute over shared water systems. Wolf et al. (2003) suggested the following relationship between change, institutions, and hydropolitical vulnerability: “The likelihood of

conflict rises as the rate of change within the basin exceeds the institutional capacity to absorb that change.”

This suggests that there are two sides to the dispute setting: the rate of change in the system and the institutional capacity. In general, most of the parameters regularly identified as indicators of water conflict are actually only weakly linked to dispute. Institutional capacity within a basin, however, whether defined as water management bodies or treaties, or generally positive international relations, is as important, if not more so, than the physical aspects of a system. It turns out, then, that very rapid changes, either on the institutional side or in the physical system, that outpace the institutional capacity to absorb those changes, are at the root of most water conflict. For example, the rapid institutional change in “internationalized” basins, i.e., basins that include the management structures of newly independent States, has resulted in disputes in areas formerly under British administration (e.g., the Nile, Jordan, Tigris-Euphrates, Indus, and Ganges-Brahmaputra), as well as in the former Soviet Union (e.g., the Aral tributaries and the Kura-Araks). On the physical side, rapid change most outpaces institutional capacity in basins that

include unilateral development projects and the absence of cooperative regimes, such as treaties, River Basin Organizations (RBOs), or technical working groups, or when relations are especially tenuous over other issues (Wolf et al. 2003).

The general assumption of this series, then, which will be explored in each regional study, is that rapid change tends to indicate vulnerability while institutional capacity tends to indicate resilience, and that the two sides must be assessed in conjunction with each other for a more accurate gauge of hydropolitical sustainability. Building on these relationships, the characteristics of a basin that would tend to enhance resilience to change include:

- international agreements and institutions, such as RBOs
- a history of collaborative projects
- generally positive political relations
- higher levels of economic development.

In contrast, facets that would tend towards vulnerability would include:

- rapid environmental change
- rapid population growth or asymmetric economic growth
- major unilateral development projects
- the absence of institutional capacity
- generally hostile relations
- natural climatic variability — naturally variable rainfall patterns with frequent periods of floods and drought.

1.2 WATER AND SECURITY

Water disputes revolve around one or more of three issues: quantity, quality, and timing. The dynamics of those three issues play out very differently within various scales related to water and security, whether internationally, intranationally, or regionally and indirectly. Each setting might be characterized as follows (for examples, see Table 1.1):

1. *International waters*: very little violence, but long processes from tension to cooperation, resulting in exacerbated political relations, inefficient water management, and ecosystem neglect; long, rich record of conflict resolution and development of resilient institutions; institutional capacity is at the heart of whether environmental stresses lead to conflict or cooperation.
2. *Intranational waters* (between sub-national political units, including states/provinces, ethnic/religious groups, and/or economic sectors): violence potential higher than in international setting; rationale for international involvement more difficult, given greater issues of national sovereignty.
3. *Regional instability (indirect)/political dynamics of loss of irrigation water*: potential for politically destabilizing processes of mass migrations to cities and/or neighboring countries when water supplies for broadly irrigated regions are threatened due to drop in quantity (including lowering of groundwater levels) or quality; issues of poverty alleviation and distribution of wealth are tied directly to amelioration of security concerns.

1.2.1 International Waters

Water is a unique and vital resource for which there is no substitute. It ignores political boundaries, fluctuates in both space and time, and has multiple and conflicting demands on its use — problems compounded in the international realm by the fact that the international law that governs it is poorly developed, contradictory, and unenforceable. It is no wonder, then, that water is perpetually suspect — not only as a cause of historic armed conflict, but as the resource that will bring combatants to the battlefield in the 21st Century. What is the likelihood that “the wars of the next century will be about water,” as some have predicted?¹

1. World Bank Vice President Ismail Serageldin, quoted in the *New York Times*, 10 August 1995. His statement is probably most often quoted. For fear of water wars, see Joyce R. Starr, “Water Wars,” *Foreign Policy* (Spring 1991): 17–36; and John Bulloch and Adel Darwish, *Water Wars: Coming Conflicts in the Middle East* (London: Victor Gollancz, 1993).

TABLE 1.1 SELECTED EXAMPLES OF WATER-RELATED DISPUTES

QUANTITY

Cauvery River, South Asia

The dispute on India's Cauvery River sprang from the allocation of water between the downstream state of Tamil Nadu, which had been using the river's water for irrigation, and upstream Karnataka, which wanted to increase irrigated agriculture. The parties did not accept a tribunal's adjudication of the water dispute, leading to violence and death along the river.

Mekong Basin, Southeast Asia

Following construction of Thailand's Pak Mun Dam, more than 25,000 people were affected by drastic reductions in upstream fisheries and other livelihood problems. Affected communities have struggled for reparations since the dam was completed in 1994.

Okavango-Makgadikgadi Basin, Southern Africa

In the Okavango-Makgadikgadi Basin, Botswana's claims for water to sustain the delta and its lucrative ecotourism industry contribute to a dispute with upstream Namibia, which wants to pipe water from the Okavango River to supply its capital city with industrial and drinking water.

QUALITY

Rhine River, Western Europe

Rotterdam's harbor had to be dredged frequently to remove contaminated sludge deposited by the Rhine River. The cost was enormous and consequently led to controversy over compensation and responsibility among Rhine users. While in this case negotiations led to a peaceful solution, in areas that lack the Rhine's dispute resolution framework, siltation problems could lead to upstream/downstream disputes.

QUANTITY AND QUALITY

Incomati River, Southern Africa

Dams and water transfers in the South African area of the Incomati River basin reduced freshwater flows and increased salt levels in Mozambique's Incomati estuary. This altered the estuary's ecosystem and led to the disappearance of salt-intolerant plants and animals that are important for people's livelihoods.

TIMING

Syr Dar'ya, Central Asia

Relations between Kazakhstan, Kyrgyzstan, and Uzbekistan—all riparians of the Syr Dar'ya, a major tributary of the disappearing Aral Sea—exemplify the problems caused by water flow timing. Under the Soviet Union's central management, spring and summer irrigation in downstream Uzbekistan and Kazakhstan balanced upstream Kyrgyzstan's use of hydropower to generate heat in the winter. But the parties are barely adhering to recent agreements that exchange upstream flows of alternate heating sources (natural gas, coal, and fuel oil) for downstream irrigation, sporadically breaching the agreements.

Sources: Wolf et al. 2005; Jägerskog 2003; Allan 2001; Elhance 1999; Bulloch and Darwish 1993; Starr 1991; Israeli-Jordanian peace treaty (www.israel-mfa.gov.il/mfa/go.asp?MFAH00pa0); Israeli-Palestinian interim agreement (www.mfa.gov.il/mfa/go.asp?MFAH00qd0#app-40, and www.nad-plo.org/fact/annex3.pdf).



Distributing jerry cans for water storage, Sudan. Photo credit: C. Reintsma, USAID.

1.2.1.1 Examining the Record

In order to cut through the prevailing anecdotal approach to the history of water conflicts, researchers at Oregon State University (OSU) undertook a three-year research project, which attempted to compile a dataset of every reported interaction between two or more nations, whether conflictive or cooperative, that involved water as a scarce and/or consumable resource or as a quantity to be managed — i.e., where water was the *driver* of the events,² over the past 50 years (Wolf et al. 2003). The study documented a total of 1,831 interactions, both conflictive and cooperative, between two or more nations over water during the past 50 years, and found the following:

First, despite the potential for dispute in international basins, the record of acute conflict over international water resources is historically overwhelmed by the record of cooperation. The last 50 years have seen only 37 acute disputes (those involving violence); of those, 30 were between Israel and one or another of its neighbors, and the violence ended in 1970. Non-Mideast cases accounted for only five acute events, while, during the same period, 157 treaties were negotiated and signed. In fact, the

only “water war” between nations on record occurred over 4,500 years ago between the city-states of Lagash and Umma in the Tigris-Euphrates basin (Wolf 1998). The total number of water-related events between nations of any magnitude are likewise weighted towards cooperation: 507 conflict-related events, versus 1,228 cooperative events, implying that violence over water is neither strategically rational, hydrographically effective, nor economically viable.

Second, despite the occasional fiery rhetoric of politicians — perhaps aimed more often at their own constituencies than at an enemy — most actions taken over water are mild. Of all the events, some 43% fell between mild verbal support and mild verbal hostility. If the next level on either side — official verbal support and official verbal hostility — is added in, the share of verbal events reaches 62% of the total. Thus almost two-thirds of all events were only verbal and more than two-thirds of those had no official sanction (Wolf 1998).

2. Excluded are events where water is incidental to the dispute, such as those concerning fishing rights, access to ports, transportation, or river boundaries. Also excluded are events where water is not the driver, such as those where water is a tool, target, or victim of armed conflict.



Fishing day, Niger. Photo credit: Marcia Macomber, OSU.

Third, there were more issues of cooperation than of conflict. The distribution of cooperative events covered a broad spectrum, including water quantity, quality, economic development, hydro-power, and joint management. In contrast, almost 90% of the conflict-laden events related to quantity and infrastructure. Furthermore, almost all extensive military acts (the most extreme cases of conflict) fell within these two categories (Wolf 1998).

Fourth, despite the lack of violence, water acted as both an irritant and a unifier. As an irritant, water can make good relations bad and bad relations worse. Despite the complexity, however, international waters can act as a unifier in basins with relatively strong institutions.

This historical record suggests that international water disputes do get resolved, even among enemies, and even as conflicts erupt over other issues. Some of the world's most vociferous enemies have negotiated water agreements or are in the process of doing so, and the institutions they have created often prove to be resilient, even when relations are strained.

The Mekong Committee, for example, established by the governments of Cambodia,

Laos, Thailand, and Viet Nam as an intergovernmental agency in 1957, exchanged data and information on water resources development throughout the Viet Nam War. Israel and Jordan have held secret "picnic table" talks on managing the Jordan River since the unsuccessful Johnston negotiations of 1953–1955, even though they were technically at war from Israel's independence in 1948 until the 1994 treaty. The Indus River Commission survived two major wars between India and Pakistan. And all 10 Nile Basin riparian countries are currently involved in senior government-level negotiations to develop the basin cooperatively, despite "water wars" rhetoric between upstream and downstream states.³

In Southern Africa, a number of river basin agreements were signed in the 1970s and 1980s, when the region was embroiled in a series of local wars. Although complex to negotiate, the agreements, once established, were one of the rare arenas of peaceful cooperation between

3. Mekong Committee from Ti Le-Huu and Lien Nguyen-Duc, *Mekong Case Study*, PCCP Series No. 10 (Paris, France: UNESCO-IHP 2003); Indus River Commission from Aaron T. Wolf, "Water and Human Security," *AVISO Bulletin*, Global Environmental Change and Human Security Project, Canada (June 1999); and Nile Basin talks from Alan Nicol, *The Nile: Moving beyond Cooperation*, PCCP Series No. 16, (Paris, France: UNESCO-IHP 2003).



Dam construction for agriculture in a rural area, Sierra Leone. Photo credit: L. Lartigue, USAID.

countries. Now that the wars in the area have ended, water cooperation is one of the foundations for regional cooperation (Turton 2004). Some have identified cooperation over water resources as a particularly fruitful entry point for building peace; however, it is unclear what conditions are required for environmental cooperation to play a major role (Conca and Dabelko 2002).

1.2.1.2 Tensions and Time Lags: Causes for Concern

So if there is little violence between nations over their shared waters, what's the problem? Is water actually a security concern at all? In fact, there are a number of issues where water causes or exacerbates tensions, and it is worth understanding these processes to know both how complications arise and how they are eventually resolved.

The first complicating factor is the time lag between when nations first start to impinge on each other's water planning and when agreements are finally, arduously, reached. A general pattern has emerged for international basins over time. Riparians of an international basin implement water development projects unilaterally — first on water within their own territory — in

attempts to avoid the political intricacies of the shared resource. At some point, one of the riparians, generally the regional power, will implement a project that impacts at least one of its neighbors. In the absence of relations or institutions conducive to conflict resolution, the project can become a flashpoint, heightening tensions and regional instability, and requiring years or, more commonly, decades, to resolve — the Indus treaty took 10 years of negotiations, the Ganges 30, and the Jordan 40 — and, all the while, water quality and quantity degrades to where the health of dependent populations and ecosystems is damaged or destroyed. This problem gets worse as the dispute gains in intensity; one rarely hears talk about the ecosystems of the lower Nile, the lower Jordan, or the tributaries of the Aral Sea—they have effectively been written off to the vagaries of human intractability. During such periods of low-level tensions, threats and disputes rage across boundaries with relations as diverse as those between Indians and Pakistanis and between Americans and Canadians. Water was the last and most contentious issue resolved in negotiations over a 1994 peace treaty between Israel and Jordan, and was relegated to “final status” negotiations — along with other of the



Hippos feeding, Botswana. Photo credit: Paul Bolstad, University of Minnesota, www.forestryimages.org.

most difficult issues such as Jerusalem and refugees — between Israel and the Palestinians.

The timing of water flow is also important; thus, the operation of dams is also contested. For example, upstream users might release water from reservoirs in the winter for hydropower production, while downstream users might need it for irrigation in the summer. In addition, water quantity and water flow patterns are crucial to maintaining freshwater ecosystems that depend on seasonal flooding. Freshwater ecosystems perform a variety of ecological and economical functions and often play an important role in sustaining livelihoods, especially in developing countries. As awareness of environmental issues and the economic value of ecosystems increases, claims for the environment's water requirements are growing. For example, in the Okavango Basin, Botswana's claims for water to sustain the Okavango Delta and its lucrative ecotourism industry have contributed to a dispute with upstream Namibia, which wants to use some of the water passing through the Caprivi Strip on its way to the delta for irrigation.

Water quality problems include excessive levels of salt, nutrients, or suspended solids. Salt intrusion can be caused by groundwater overuse

or insufficient freshwater flows into estuaries. For example, dams in the South African part of the Incomati River basin reduced freshwater flows into the Incomati estuary in Mozambique and led to increased salt levels. This altered the estuary's ecosystem and led to the disappearance of salt-intolerant flora and fauna important for people's livelihoods (the links between loss of livelihoods and the threat of conflict are described below). The same exact situation exists on the border between the United States and Mexico, where high salinity problems have not only reduced agricultural productivity, but have severely altered ecosystems in the Colorado and Rio Grande rivers and impacted marine flora and fauna in the Gulfs of California and Mexico, where the respective rivers terminate.

Excessive amounts of nutrients or suspended solids can result from unsustainable agricultural practices, eventually leading to erosion. Nutrients and suspended solids pose a threat to freshwater ecosystems and their use by downstream riparians, as they can cause eutrophication and siltation, respectively, which, in turn, can lead to loss of fishing grounds or arable land. Suspended solids can also cause the siltation of reservoirs and harbors: for example, Rotterdam's harbor had



Dam catchment in Ethiopia, where rapid siltation threatens municipal drinking water supplies. Photo credit: Badege Bishaw, OSU.

to be dredged frequently to remove contaminated sludge deposited by the Rhine River. The cost was enormous, and consequently led to conflict over compensation and responsibility among the river's users. Although negotiations led to a peaceful solution in this case, without such a framework for dispute resolution, siltation problems can lead to upstream/downstream disputes such as those in the Lempa River basin in Central America (Lopez 2004).

1.2.1.3 Institutional Capacity: The Heart of Conflict Management

Most authors who write about hydropolitics, and especially those who explicitly address the issue of water conflicts, hold to the common assumption that it is the scarcity of such a critical resource that drives people to conflict. It feels intuitive—the less there is of something, especially something as important as water, the more dearly it is held and the more likely people are to fight over it.

The three-year OSU study worked to tease out just what the indicators of conflict are. A 100-layer Geographic Information System (GIS) was compiled—a spatial database of all the

parameters that might prove part of the conflict/cooperation story, including physical (e.g., runoff, droughts), socioeconomic (e.g., GDP, rural/urban populations), and geopolitical (e.g., government type, votes on water-related UN resolutions) parameters. With this GIS in place, a statistical snapshot was developed of each setting for each of the events over the last 50 years of conflict or cooperation.

The results were surprising, and often counterintuitive. *None* of the physical parameters was statistically significant — arid climates were no more conflictive than humid climates, and international cooperation actually *increased* during droughts. In fact, when the numbers were run, almost no single variable proved causal — democracies were as conflictive as autocracies, rich countries as poor countries, densely populated countries as sparsely populated ones, and large countries the same as small countries.

It was close reflection of aridity that finally put researchers on the right track: institutional capacity was the key. Naturally arid countries were cooperative: if one lives in a water-scarce environment, one develops institutional strategies for adapting to that environment. Once institutions —



As countries on the continent industrialize so do the risks associated with pollution increase. Paper and pulp mill in Mpumalanga province, South Africa, Incomati River basin. Photo credit: Anton Earle.

whether defined by formal treaties, informal working groups, or generally warm relations — and their relationship to the physical environment became the focus, researchers began to get a clear picture of the settings most conducive to political tensions in international waterways. We found that the likelihood of conflict increases significantly whenever two factors come into play. The first is that some large or rapid change occurs in the basin's physical setting — typically the construction of a dam, river diversion, or irrigation scheme — or in its political setting, especially the breakup of a nation that results in new international rivers. The second factor is that existing institutions are unable to absorb and effectively manage that change. This is typically the case when there is no treaty spelling out each nation's rights and responsibilities with regard to the shared river, nor any implicit agreements or cooperative arrangements. Even the existence of technical working groups can provide some capability to manage contentious issues, as they have in the Middle East.

The overarching lesson of the study is that unilateral actions to construct a dam or river diversion *in the absence* of a treaty or institutional mechanism that safeguards the interests of other

countries in the basin is highly destabilizing to a region, often spurring decades of hostility before cooperation is pursued. In other words, the red flag for water-related tension between countries is not water stress per se, as it is within countries, but rather the unilateral exercise of domination of an international river, usually by a regional power.

In the Jordan River Basin, for example, violence broke out in the mid-1960s over an “all-Arab” plan to divert the river's headwaters (itself a pre-emptive move to thwart Israel's intention to siphon water from the Sea of Galilee). Israel and Syria sporadically exchanged fire between March 1965 and July 1966. Water-related tensions in the basin persisted for decades and only recently have begun to dissipate.

A similar sequence of events transpired in the Nile basin, which is shared by 10 countries — of which Egypt is last in line. In the late 1950s, hostilities broke out between Egypt and Sudan over Egypt's planned construction of the High Dam at Aswan. The signing of a treaty between the two countries in 1959 defused tensions before the dam was built. But no water-sharing agreement exists between Egypt and Ethiopia, where some 55% of the Nile's flow originates, and a war of words has raged between these two



Niger River in Niger; dugout canoes filled with squashes. Photo credit: William M. Ciesla, Forest Health Management International, www.forestryimages.org

nations for decades. As in the case of the Jordan, in recent years the Nile nations have begun to work cooperatively toward a solution thanks in part to unofficial dialogues among scientists and technical specialists that have been held since the early 1990s, and more recently a ministerial-level “Nile Basin Initiative” facilitated by the United Nations and the World Bank.

1.2.2 Intranational Waters

The second set of security issues occur at the sub-national level. Much literature on transboundary waters treats political entities as homogeneous monoliths: “Canada feels . . .” or “Jordan wants.” Analysts are only recently highlighting the pitfalls of this approach, often by showing how different subsets of actors relate very different “meanings” to water. Rather than being simply another environmental input, water is regularly treated as a security issue, a gift of nature, or a focal point for local society. Disputes, therefore, need to be understood as more than “simply” over a quantity of a resource, but also over conflicting attitudes, meanings, and contexts. Throughout the world, local water issues revolve around core values that often date back generations. Irrigators, indigenous populations, and environmentalists, for

example, can see water as tied to their very ways of life, and increasingly threatened by newer uses for cities and hydropower. Moreover, the local setting strongly influences international dynamics and vice versa.

If there is a history of water-related violence, and there is, it is a history of incidents at the sub-national level, generally between tribes, water-use sectors, or states/provinces. In fact, the recent research at OSU suggests that, as the scale drops, the likelihood and intensity of violence rises.⁴ There are many examples of internal water conflicts ranging from interstate violence and death along the Cauvery River in India, to the USA, where California farmers blew up a pipeline meant for Los Angeles, to inter-tribal bloodshed between Maasai herdsman and Kikuyu farmers in Kenya. The inland, desert state of Arizona in the USA even commissioned a navy (made up of one ferryboat) and sent its state militia to stop a dam and diversion on the Colorado River in 1934.

Another contentious issue is water quality, which is also closely linked to water quantity. Decreasing water quality can render it inappropriate for some uses, thereby aggravating its

4. Giordano et al. 2002.



Washing day in the town of Menongue on the Cuebe River, southern Angola. Photo credit: Anthony Turton.

scarcity. In turn, decreasing water quantity concentrates pollution, while excessive water quantity, such as flooding, can lead to contamination by sewage. Low water quality can pose serious threats to human and environmental health. Water quality degradation is often a source of dispute between those who cause degradation and the groups affected by it. As pollution increasingly impacts upon livelihoods

and the environment, water quality issues can lead to public protests.

One of the main causes of declining water quality is pollution, e.g., through industrial and domestic wastewater or agricultural pesticides. In Tajikistan, for example, where environmental stress has been linked to civil war (1992–1997), high levels of water pollution have been identified as one of the key environmental issues threatening human development and security. Water pollution from the tanning industry in the Palar Basin of the Indian state of Tamil Nadu makes the water within the basin unfit for irrigation and consumption. The pollution contributed to an acute drinking water crisis, which led to protests by the local community and activist organizations, as well as to disputes and court cases between tanners and farmers (Carius et al. 2003).

1.3 REGIONAL INSTABILITY: POLITICAL DYNAMICS OF LOSS OF IRRIGATION WATER

As water quality degrades—or quantity diminishes—over time, the effect on the stability of a region can be unsettling. For example, for 30 years the Gaza Strip was under Israeli occupation. Water quality deteriorated steadily, saltwater intrusion degraded local wells, and water-related diseases took a rising toll on the people living there. In 1987, the intifada, or Palestinian



Modern pipeline system for irrigation in an oasis in the Draa Valley, Morocco. Photo credit: Daniel Malzbender.

uprising, broke out in the Gaza Strip, and quickly spread throughout the West Bank. Was water quality the cause? It would be simplistic to claim direct causality. Was it an irritant exacerbating an already tenuous situation? Undoubtedly.

An examination of relations between India and Bangladesh demonstrates that these internal instabilities can be both caused and exacerbated by international water disputes. In the 1960s, India built a barrage at Farakka, diverting a portion of the Ganges flow away from its course into Bangladesh, in an effort to flush silt away from Calcutta's seaport, some 100 miles to the south. In Bangladesh, the reduced upstream flow resulted in a number of adverse effects: degraded surface and groundwater, impeded navigation, increased salinity, degraded fisheries, and endangered water supplies and public health. Migration from affected areas further compounded the problem. Ironically, many of those displaced in Bangladesh have found refuge in India.

Two-thirds of the world's water use is for agriculture so, when access to irrigation water is threatened, one result can be movement of huge populations of out-of-work, disgruntled men from the country-side to the cities—an invariable recipe for political instability. In pioneering work, Sandra Postel identified those countries that rely heavily on irrigation, and whose agricultural water supplies are threatened either by a decline in quality or quantity. The list coincides precisely with regions of the world community's current security concerns, where instability can have profound effects: India, China, Iran, Pakistan, Uzbekistan, Iraq, Bangladesh, and Egypt (Postel and Wolf 2001).

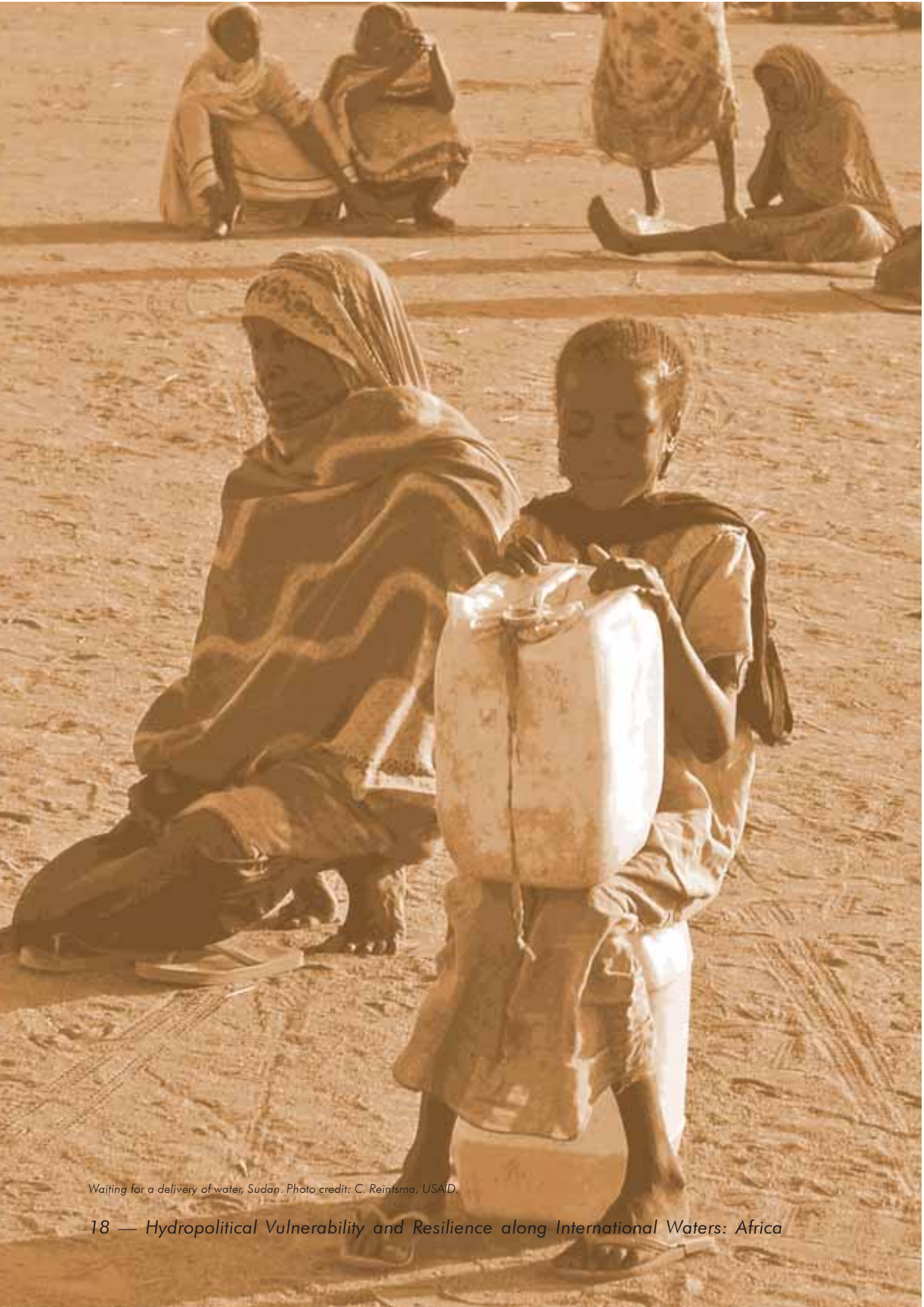
Water management in many countries is also characterized by overlapping and competing responsibilities among government bodies.

Disaggregated decision-making often produces divergent management approaches that serve contradictory objectives and lead to competing claims from different sectors. And such claims are even more likely to contribute to disputes in countries where there is no formal system of water-use permits, or where enforcement and monitoring are inadequate. Controversy also often arises when management decisions are formulated without sufficient participation by local communities and water users, thus failing to take into account local rights and practices. Protests are especially likely when the public suspects that water allocations are diverting public resources for private gain or when water use rights are assigned in a secretive and possibly corrupt manner, as demonstrated by the violent confrontations in 2000 following the privatization of Cochabamba, Bolivia's water utility (Postel and Wolf 2001).

Finally, there is the human security issue of water-related disease. It is estimated that between 5 and 10 million people die each year from water-related diseases or inadequate sanitation. More than half the people in the world lack adequate sanitation. Eighty percent of disease in the developing world is related to water (Gleick 1998). This is a crisis of epidemic proportions, and the threats to human security are self-evident.



Washing dishes, Central African Republic. Photo credit: Jane McCauley Thomas, College of the Sequoias.



Waiting for a delivery of water, Sudan. Photo credit: C. Reintsma, USAID.